To Be Elite, You Have to Eat:

Nutrition Recommendations for the Pediatric Athlete

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Indiana Academy of Nutrition & Dietetics

Speaker Disclosures

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No speaker disclosures.

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No speaker disclosures.

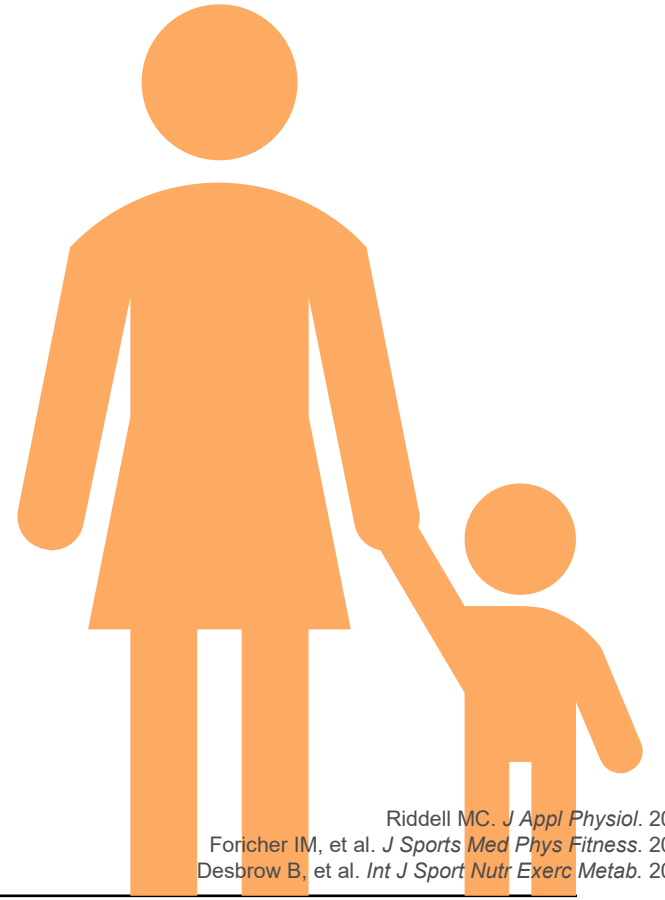
Learning Objectives

- Identify the key nutrients that are essential for optimal athletic performance in pediatric athletes.
- Explain the importance of proper nutrient timing when fueling for sport.
- Differentiate between effective ergogenic aids and marketing madness.
- Understand the consequences of energy deficiency in sport.

AN EMPTY TANK GETS YOU NOWHERE.

Adult vs Pediatric Recommendations

- Research and practical guidelines are currently **limited**
- Factors to consider:
  - Growth, development, and pubertal status
  - Limited endogenous carbohydrate stores
  - Higher fat oxidation
- Experts suggest adult carbohydrate guidelines can be used for teens, given the intensity and duration of sports



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Desbrow B, et al. *Int J Sport Nutr Exerc Metab*. 2014.

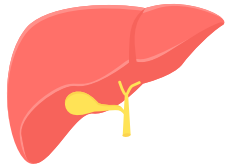
Key Nutrients for Performance

Carbohydrates, Protein, and Color

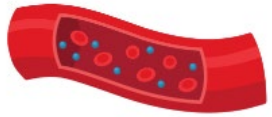
Carbohydrates

- Predominant **fuel** for exercise
- Three major sources in the body:

MUSCLE



LIVER



BLOOD

- Fasting affects glycogen stores
- Consumption is necessary to replenish stores, help meet energy requirements, and achieve optimal performance
- **Recommendation:** 3-12 grams/kg/day

Image Credit: Christina DaSilva, made with canva.com

Jacobs KA, Sherman WM. *Int J Sport Nutr.* 1999.
Coyle EF. *Am J Clin Nutr.* 1995.
Burke LM, et al. *J Sports Sci.* 2011.
Thomas DT, et al. *J Acad Nutr Diet.* 2016.
Fallowfield JL, Williams C. *Int J Sports Nutr.* 1993.

Protein

- Exercise plays a major role in skeletal muscle protein turnover
- **Repairing** and **rebuilding** muscle

Rennie MJ, et al. *Clin Sci (Lond).* 1982.
Burd NA, et al. *J Nutr.* 2011.
Areta JL, et al. *J Physiol.* 2013.
Snijders T, et al. *J Nutr.* 2015.
Arent SM, et al. *Nutrients.* 2020.

Protein

- Exercise plays a major role in skeletal muscle protein turnover
- **Repairing** and **rebuilding** muscle
- "Window of anabolic opportunity" is bigger than originally thought:
  - Up to 3 hours post-exercise for benefits in lean mass and strength gain
  - Intake before sleep may lead to further adaptations
  - Adequate total daily protein intake is crucial
- **Recommendation:** 1.2-1.7 grams/kg/d, depending on type and intensity

Rennie MJ, et al. *Clin Sci (Lond).* 1982.
Burd NA, et al. *J Nutr.* 2011.
Areta JL, et al. *J Physiol.* 2013.
Snijders T, et al. *J Nutr.* 2015.
Arent SM, et al. *Nutrients.* 2020.

Color

- Exercise causes an increased physiological demand and stress on the body
- Vitamins and minerals necessary for:
  - Energy metabolism as coenzymes and cofactors
  - Antioxidants and reducing oxidative damage
  - Bone health and development
  - Red blood cell function
  - Strong immune system

Byrd-Bredbenner C, et al. *Wardlaw's Perspective in Nutrition.* 2013.
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Wolinsky I, Driskell JA. *Sports Nutrition: Energy Metabolism and Exercise*. 2007.
Ross CA, et al. *Modern Nutrition in Health and Disease.* 2014.
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Gleeson M, et al. *J Sports Sci.* 2004.

Fat

- **Essential** for:
  - Fueling endurance exercise
  - Absorption of fat-soluble vitamins and phytonutrients
  - Providing essential fatty acids
  - Meeting elevated energy needs
  - Long-term cardiovascular and overall health
- Types of fat:
  - Saturated: solid at room temperature, animal derived
  - Unsaturated: the “heart healthy” fats, mostly plant derived
- **Recommendation:** 20-35% of total energy (<10% from saturated fat)

Trumbo P, et al. *J Am Diet Assoc.* 2002.
Eckel RH, et al. *J Am Coll Cardiol.* 2014.

Optimal Nutrient Timing

What, When, and Why

Before Training

- Consume **carbohydrates**, **protein**, and **color** – with snacks throughout the day – to…
  - Maintain energy levels
  - Fuel the brain
  - Minimize fatigue during training
- **Carbohydrates** "top off" existing glycogen stores pre-exercise
  - **Recommendation:** 1-4 grams/kg of carbohydrate 1-4 hours pre-exercise
- Limit fat, fiber, and protein intake to limit GI distress
- **Hydrate**! Even when not thirsty

Sherman WM, et al. *Med Sci Sports Exerc.* 1991.
Sherman WM, et al. *Am J Clin Nutr.* 1991.
Burke LM, et al. *J Sports Sci.* 2004.
Ormsbee MJ, et al. *Nutrients.* 2014.
Rehrer NJ, et al. *Int J Sports Nutr.* 1992.
Rico-Sanz J, et al. *Int J Sports Med.* 1996.

Example:

WAKE UP ~6:30AM

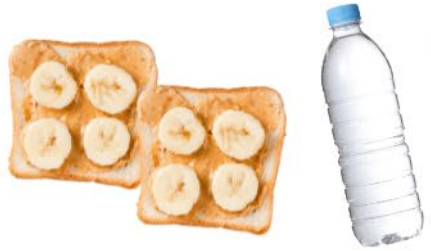
SCHOOL STARTS 7:30AM

LUNCH

Pair carbs, protein, & color. HYDRATE!:
- Lunchmeat Sandwich w/ Fruit/Veggie, Pretzels, and Fruit Snacks

BREAKFAST

Pair carbs & protein. HYDRATE!:
- Egg Sandwich w/ Fruit
- Oatmeal w/ Fruit
- PB Banana Toast



SCHOOL ENDS 2:30PM

PRE-PRACTICE SNACK

Carb-rich snack for energy during practice:
- Applesauce
- Fresh Fruit
- Granola Bar
- Trail Mix
- PB Crackers

Image Credit: Christina DaSilva, made with canva.com

Pre-Training Snack

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>2
HOURS BEFORE PRACTICE OR GAME

- Uncrustables Sandwich
- CLIF Bar
- Gatorade Protein Bar
- Trail Mix
- PB Crackers
- Greek Yogurt w/ Fruit + Granola

FOCUS ON REPLENISHING CARBS AND PROTEIN

1-2
HOURS BEFORE PRACTICE OR GAME

- Pretzels
- Goldfish
- Oatmeal
- Belvita Bar
- Nature Valley Biscuits

FOCUS ON CARBS THAT TAKE LONGER TO DIGEST

<30
MINUTES BEFORE PRACTICE OR GAME

- GogoSqueez Applesauce
- Honey Stinger Waffle
- Fruit Snacks
- Chewy Bar
- Gatorade

FOCUS ON GETTING QUICK ENERGY THROUGH SIMPLE CARBS

Image Credit: Christina DaSilva, made with canva.com

During Training

- Replenish **carbohydrates** and **rehydrate**
- Carb-rich snack to maintain blood glucose levels, spare muscle glycogen, and delay fatigue
  - **Recommendation:** 30-60 grams/hour
- Individual sweat tendencies affect rehydration requirements
  - **Recommendation:** 0.4-0.8 L/hour (+ sodium)
  - Individual hydration plan to prevent excessive dehydration [>2% body weight reduction from baseline]

Image Credits: canva.com

Jeukendrup AE. *Sports Med.* 2014.
Baker LB, et al. *Nutrients.* 2015.
Welsh RS, et al. *Med Sci Sports Exerc.* 2002.
American College of Sports Medicine, et al. *Med Sci Sports Exerc.* 2007.
Thomas DT, et al. *J Acad Nutr Diet.* 2016.

After Training

- Goals: refuel, repair, and rehydrate
- Consume **carbohydrates** and **protein**:
  - **Recommendations:**
    - 1-1.2 grams/kg/hour of carbohydrates for the first 2 hours
    - High quality protein consumption following a 3:1 ratio

Beelen M, et al. *Int J Sport Nutr Exerc Metab.* 2010.
Maughan RJ, et al. *Sport Sci Exch.* 1996.
Shirreffs SM, et al. *Med Sci Sports Exerc.* 1996.
Gonzalez-Alonso J, et al. *Int J Sports Med.* 1992.

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    - 1-1.2 grams/kg/hour of carbohydrates for the first 2 hours
    - High quality protein consumption following a 3:1 ratio
- **Water** may not be an effective re-hydrator
  - Pair with electrolyte-rich foods

Beelen M, et al. *Int J Sport Nutr Exerc Metab.* 2010.
Maughan RJ, et al. *Sport Sci Exch.* 1996.
Shirreffs SM, et al. *Med Sci Sports Exerc.* 1996.
Gonzalez-Alonso J, et al. *Int J Sports Med.* 1992.

Electrolyte Sports Drinks

- Sodium content is essential, as it is the main electrolyte lost in sweat
- Some advertise having less sugar than Gatorade, but sugar is energy
- Some can be OK if you like the taste, but not recommended as a sports drink

Example:

PRACTICE
~3:30PM

POST-PRACTICE SNACK

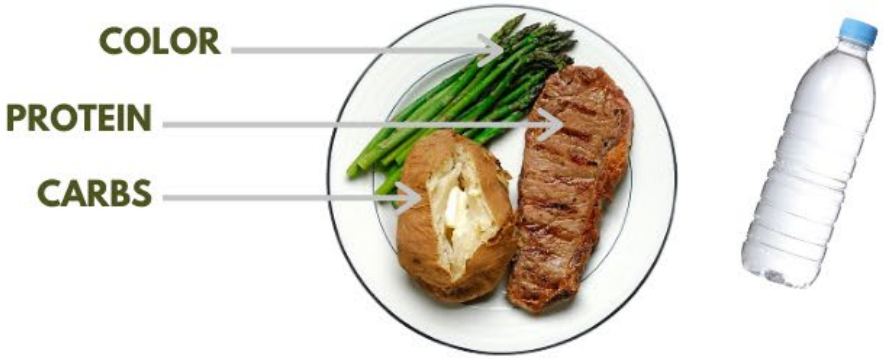
Carbs & protein to replenish energy and repair muscle. HYDRATE!:
- Greek Yogurt and Fruit
- Chocolate Milk
- Jerky and Crackers

PM SNACK

Carbs & protein to repair muscles and prepare for tomorrow. HYDRATE!:
- PB+J
- Apple and PB
- Trail Mix

DINNER

Pair carbs, protein, & color. HYDRATE!



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Hydration

- Essential for optimal athletic performance.
- Needs vary depending on individual sweat tendencies & environment.

Recommendations:

- Pre-hydrate to start euhydrated. *5-10 mL/kg 2-4 hrs before.*
- Fluid + electrolytes during to avoid excessive dehydration and electrolyte imbalances. *0.4-0.8 L/hr during.*
- Replenish fluid-electrolyte deficit post-exercise. *1.25-1.5 L fluid/kg BW lost.*

American College of Sports Medicine, et al. *Med Sci Sports Exerc.* 2007.
Thomas DT, Erdman KA, Burke LM. *J Acad Nutr Diet.* 2016.

Hydration

Calculating Sweat Rate: *SWEAT LOST (mL) / TIME (h) = mL/h*

Weight lost during exercise (g) = [pre-exercise BW (kg) - post-exercise BW (kg)] x 1000

SWEAT LOST = weight lost (g) + fluid intake (mL) - urine volume (mL)

EXERCISE TIME (h) = minutes / 60

American College of Sports Medicine, et al. *Med Sci Sports Exerc.* 2007.

Urine Color Assessment

1 to 2: Hydrated
Pale, odourless and plentiful urine usually means that you are well hydrated.
Keep drinking at the same rate.

3 to 4: Mildly dehydrated
Slightly darker yellow urine usually means that you need to drink more water.
Drink a glass of water now.

5 to 6: Dehydrated
Medium-dark yellow urine usually means that you are dehydrated.
Drink 2-3 glasses of water now.

7 to 8: Very dehydrated
Darker, strong-smelling urine in small amounts can be a sign of dehydration.
Drink a large bottle of water immediately.

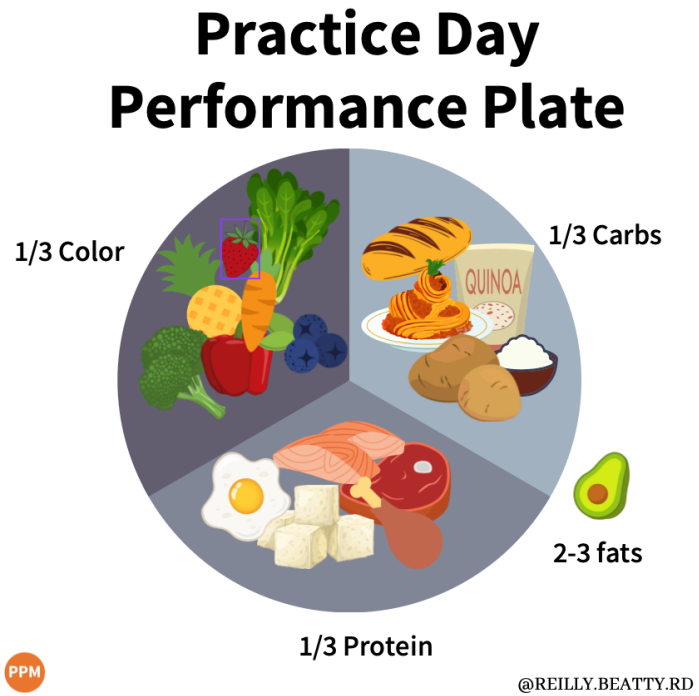
Environmental Health. *NSW Health. 2024.*

Basic Fueling Strategies

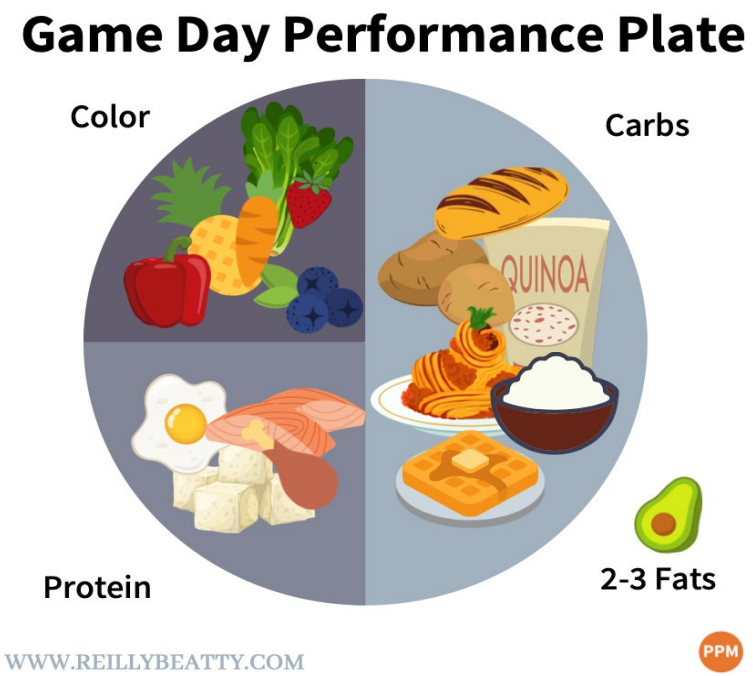
How to Build a Performance Plate

Performance Plates

PRIORITY: RECOVERY



PRIORITY: FUEL & RECOVER



PRIORITY: ENERGY

Image Credits: https://reillybeatty.com/how-to-build-a-performance-plate-for-athlete-diet/

Example:

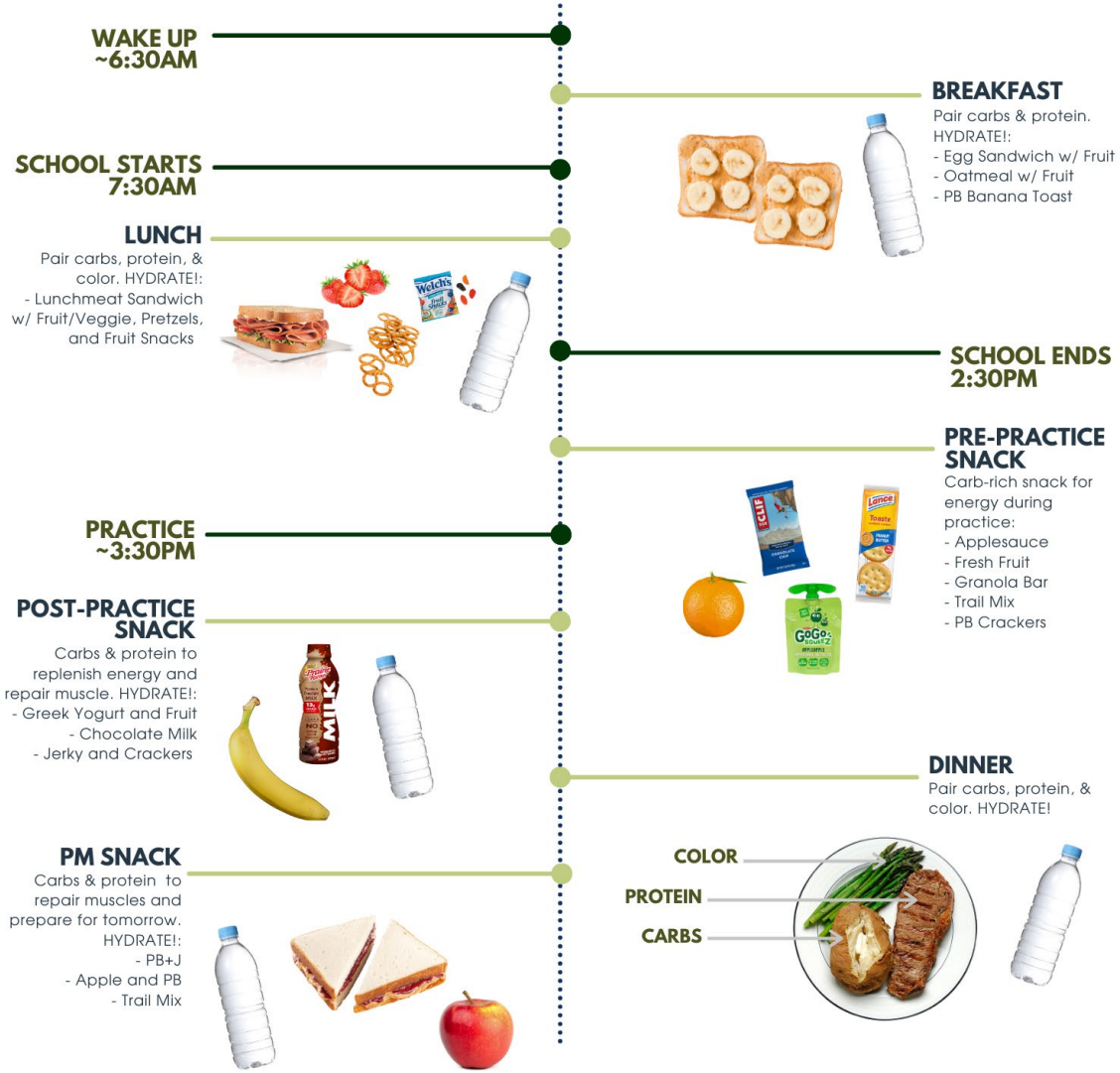


Image Credit: Christina DaSilva, made with canva.com

Athlete Case Study:

17 y/o M high school soccer player. 5’10” and 68 kg.

Plays the entire game (90 minutes) as defensive midfielder.

C/o second half fatigue, muscle soreness, and occasional calf cramping.

Reports white sweaty residue after training.

Goal of gaining muscle mass and playing soccer in college.

Athlete Case Study:

Diet Recall:

- Breakfast – smoothie (heavy cream + yogurt + frozen fruit)
- Lunch – turkey + cheese sandwich
- Pre-Practice – Uncrustable
- Minimal fluid intake during practice/games
- Post-Practice – protein shake
- Dinner – chicken + pasta
- Snack – 5-7 Oreos + big bowl of ice cream

Takeaways: minimal color + complex carbs; inadequate fluid and energy intake

Athlete Case Study:

Anthropometrics: 70”, 68 kg

Daily Calorie Goal: **2500 – 3300 kcals**, depending on training load

Recommended Macronutrient Consumption:

- Carbohydrates: 476 g/day (62% of calorie intake) [~7 g/kg/d]
- Protein: 135 g/day (18% of calorie intake) [~2 g/kg/d]
- Fat: 66 g/day (20% of calorie intake)

Hydration

Sweat Rate: *SWEAT LOST (mL) / TIME (h) = mL/h*

Sweat Rate = {([pre-exercise BW (kg) – post-exercise BW (kg)] x 1000) + fluid intake (mL) – urine volume (mL)} / time (h) = mL/h

BW Before (kg)	BW After (kg)	Change in BW (g)	Fluid Volume (mL)	Urine Volume (mL)	Sweat Lost (mL)	Exercise Time (h)	Sweat Rate (mL/h)
68.18	67.36	820*	960	0	1780	2	890 mL/h

Recommendation: consume ~16-26 oz/h during exercise; 35-40 oz after exercise.

**loss of 1.2% BW*

American College of Sports Medicine, et al. *Med Sci Sports Exerc.* 2007.
Environmental Health. *NSW Health.2024.*

Example Fueling Timeline:

- **Breakfast:** *goal of 90g CHO + 30g PTN + 20g fat*
  - 2 egg sandwich on a bagel (60g CHO, 14g PTN) with a yogurt, strawberry & granola bowl (27g CHO, 16g PTN)
- **Lunch:** *goal of 90g CHO + 30g PTN + 20g fat*
  - Turkey, cheese, spinach, & avocado sandwich (30g CHO, 21g PTN) with apples and peanut butter (30g CHO, 7g PTN) and a Nutrigrain bar (25g CHO)
- **Pre-Training Snack:** *goal of 60g CHO + 10g PTN + 5g fat*
  - 1 Uncrustable (28g CHO, 6g PTN) with a 16 oz Gatorade (30g CHO)
- **During Training:** *goal of 30-60g CHO*
  - 12 oz Gatorade (22g CHO) with a banana (30g CHO) and a pickle spear
- **Post-Training Snack (15-60 min after training):** *goal of 60g CHO + 20g PTN + 5g fat*
  - 16 oz Prairie Farms chocolate milk (60g CHO, 15g PTN)
- **Dinner:** *goal of 90g CHO + 30g PTN + 20g fat*
  - 1.25 cups whole wheat spaghetti (60g) with meat, spinach, and onion sauce (15g CHO, 28g PTN) and a small dinner roll (15g)
- **Bedtime Snack:** *goal of 60g CHO +10g PTN + 5g fat*
  - PB&J on whole wheat bread (60g CHO, 11g PTN)

AN EMPTY TANK GETS YOU NOWHERE.

01 CARBS BEFORE

02 REPLENISH & REHYDRATE DURING

03 CARBS + PROTEIN AFTER

Image Credit: Christina DaSilva, made with canva.com

Supplements

Effective Ergogenic Aid or Marketing Madness?

The Australian Institute of Sport: SUPPLEMENTS

https://www.ais.gov.au/nutrition/supplements

CONSIDERATIONS:

- Safety
- Effectiveness
- Legality
- Practicality
- Quality

INFORMED SPORT

USP DIETARY SUPPLEMENT VERIFIED

INFORMED-CHOICE.ORG Trusted by sport

NSF

ConsumerLab.com Be Sure It's CL Approved

Caffeine

EVIDENCE LEVEL: A – strong evidence for use in certain settings

DOSAGE: 2-3mg/kg (~200mg)

SAFETY: ≤400mg/day or ≤200 mg at any one time, and younger than age 18 should consume no more than 2.5mg/kg/day

EFFECTIVENESS: improves endurance performance regardless of if it's taken before or during performance, CNS stimulant, individual response varies, plateau effectiveness occurs ~200mg

FOOD: coffee, tea, chocolate, soda

(Australian Sports Commission, 2022)

Creatine Monohydrate

EVIDENCE LEVEL: A – strong evidence for use in certain settings

DOSAGE: 5g of creatine monohydrate taken 4 times/day for 5 days prior to activity “creatine loading” and then 3-5g/day “maintenance dose” OR skip “loading dose” and take 3-5g/day for 4 weeks to achieve similar results

SAFETY: no evidence of serious side effects, however some reports of rapid weight gain and GI distress

EFFECTIVENESS: increase muscle creatine stores which improves high-intensity exercise performance, support recovery

FOOD: meat and fish, but supplement needed to achieve required levels

(Australian Sports Commission, 2022)

Relative Energy Deficiency in Sport

The Consequences of Underfueling

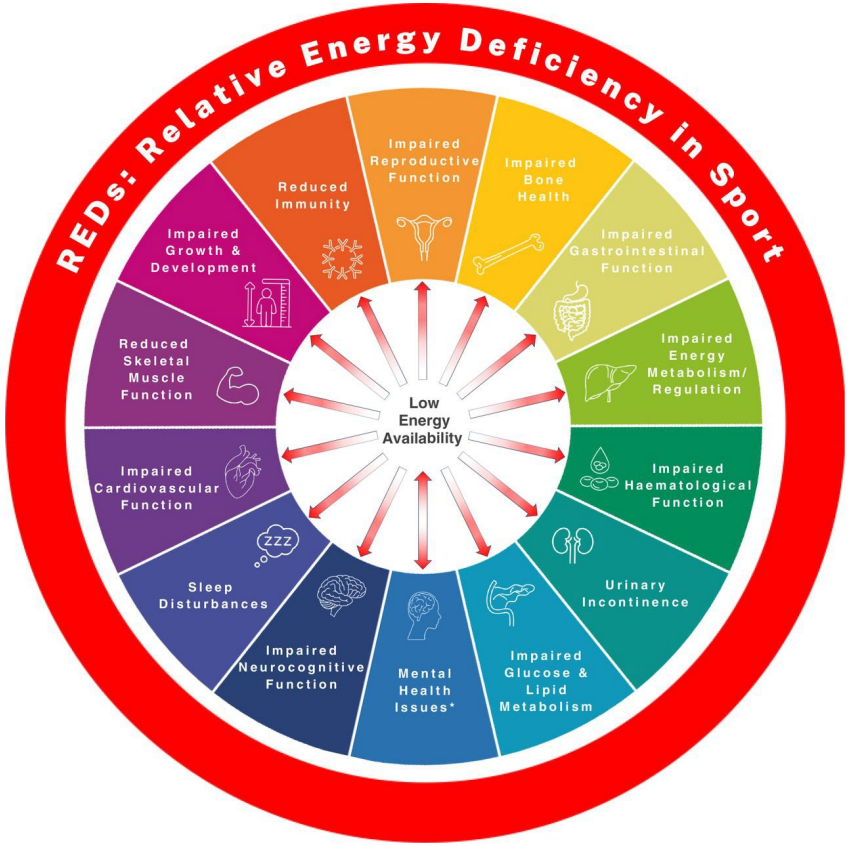
Relative Energy Deficiency in Sport

What is REDs?

- May be intentional or unintentional
- Females or males
- Experiencing prolonged or severe low energy availability without refueling

REDs Health Model

- Reduced immunity
- Impaired bone health
- Mental issues
- Impaired cardiovascular function



(Mountjoy et al., 2023)

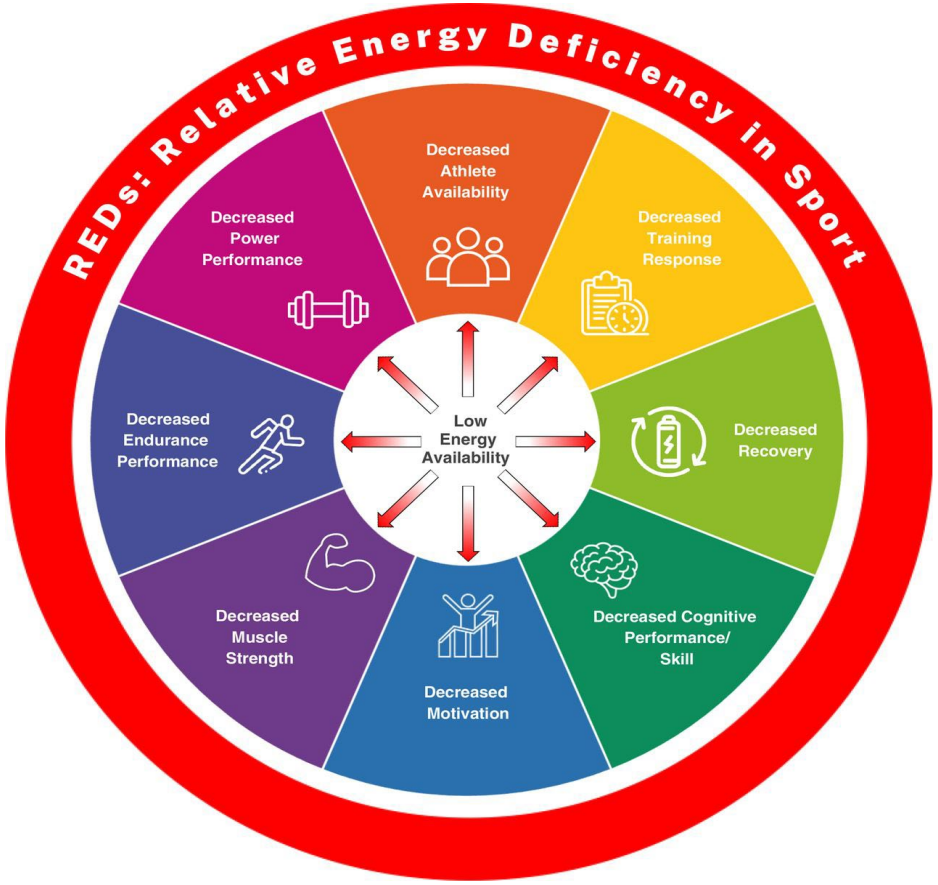
Causes of REDs

- Disordered Eating/Eating Disorder (DE range 6-45% in females, 0-19% in males, wide range due to inconsistencies in studies)
- “Making weight”
- Attempting to decrease body fat or body mass (for health, for performance, for aesthetics)
- Rapid increase in energy expenditure
- Altitude training
- Decreased appetite with increased energy expenditure
- Cultural
- Decreased access to food
- Food insecurity
- Lack of nutrition knowledge for intense activity

(Burke et al., 2021)

REDs - The Performance Model

- Results in decreased muscle strength
- Decreased power performance
- Decreased recovery
- Deceased motivation



(Mountjoy et al., 2023)

Case Study

16-year-old female admitted with weight loss and bradycardia

Activities included 30 miles per week of competitive running with cross country and track. Minutes per mile unknown but “very competitive”

Strength training for 60-90 minutes twice a week

Weight loss of 10% usual body weight within roughly 3 months

Case Study, continued

Diet: self-restricted diet of gluten/grain free, dairy free and low FODMAP

- Was not eating all foods allowed on low FODMAP, GI workup was negative, no reason to follow a restrictive diet, advised to start adding 1-2 foods in per week to increase variety

Diet while inpatient: Patient/family selected menu of at least 2700 calories per day. Patient able to achieve goal with ONS

Declined outpatient referral to Charis Center; opted for weight checks with PCP or adolescent medicine

Diet Prescription for Home

Reviewed SNCM patient education for distance-based runners

Focus on high calorie and high protein foods

- Apples with peanut butter
- Cheese stick and a banana

Add in high calorie foods from low FODMAP diet (avocado, peanut butter, almond butter, olive oil)

Fuel with carbohydrates prior to activity and carbohydrates plus protein after activity

Aim for 3 meals and 3 snacks per day

Follow Up

Readmitted a few months later with weight loss and bradycardia

Changes: Added in walking 30 minutes daily on treadmill prior to school and incredibly upset when asked to cut back

Reported intake of 3000 calories/day, but exhibited weight loss

Is this still REDs??

Transitioned to more ED focus due to additional physical activity, very anxious when attempting to add in new or additional foods, even when trying to accommodate diet preferences (low FODMAP, GF/DF)

THANK YOU!

Questions?

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Additional Resources

Pediatric Sports Nutrition:

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Additional Resources

Fat:

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