Fueling Growth, Health, and Performance in the High School Athlete

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Disclosure

I, Melanie Battaglia, have no financial relationships to be discussed, directly or indirectly, referred to or illustrated with or without recognition within the presentation.

Objectives

- Recognize nutrition recommendations for growth, development, and sports performance
- Describe the common nutrition related challenges high school athletes face
- Select practical nutrition tools and resources to use in a high school setting
- Identify the nutrition interventions dietitians use with high school athletes

Research Considerations

- Many of our adolescent nutrition recommendations are based on:
  - Adult athlete studies
  - Predictive equations
  - Clinical experience

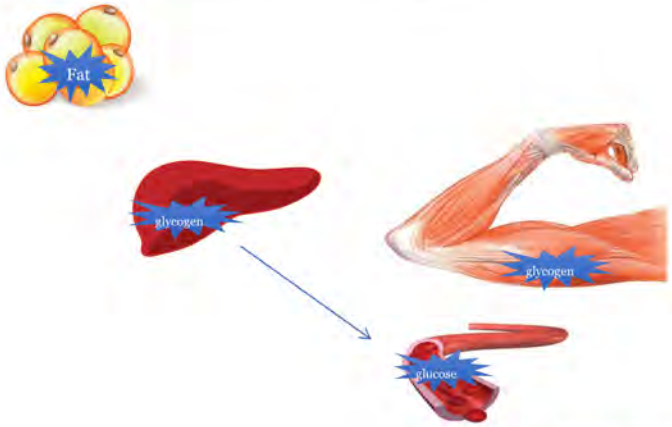
Nutrition Recommendations for High School Athletes

Adolescent Overview

- **Increased nutritional needs**
  - Bone growth
  - Muscle development
  - Metabolic and hormonal fluctuations
  - Maturation of organ systems
- **Factors impacting nutritional needs**
  - Rate of growth
  - Maturation status and timing
  - Percent muscle and body fat
  - Sport and exercise demands
  - Injury status
  - Medical conditions
  - Increased independence to make their own food choices

Fuel Utilization

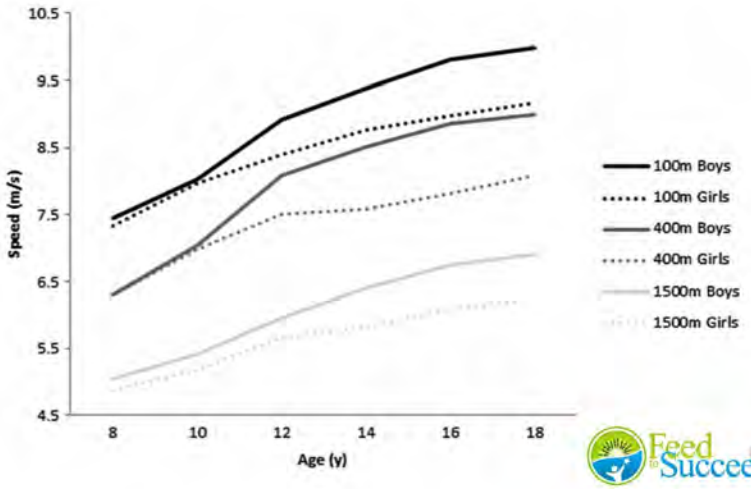
- Children rely more on aerobic energy metabolism → fat as major energy source during exercise
- Children/early in adolescence they are usually less successful in high-power anaerobic activities, such as sprinting and jumping → glycogen (carb stores) as major energy source during exercise
- GI tract absorptive capacity improves throughout adolescence and ability to absorb carbs improves



Armstrong, 2015

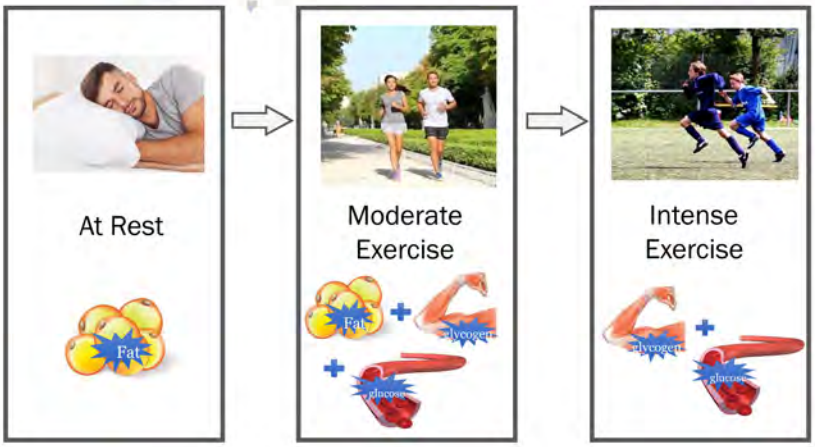
Fuel Utilization

- Through puberty, athletes may experience greater improvement in anaerobic races (100m and 400m sprints) than in performances supported by aerobic/oxidative metabolism (1500m).
- Greatest improvement seen in boys.



Armstrong, 2015

Fuel Utilization



Increased Nutrition Needs

- Protein
- Calcium
- Iron
- Energy

Not meeting increased needs may put the athlete at risk for:

- Vitamin and mineral deficiencies
- Poor performance
- Low-energy availability

Increased Nutrition Needs

Iron

- Increased needs during adolescence
  - Growth of bones and muscle
  - Increased plasma volume
  - Onset of menstruation in female
- 9-16% female adolescents iron deficient
- Girls: 15 mg/day
- Boys: 11 mg/day

Calcium

- Adolescent calcium absorption and recommendations are high
  - 40% of total skeletal bone mass acquired during adolescent years
- 80% of girls 9 – 18y below RDA
- RDA: 1300 mg/day

Protein Needs

Age	DRI – Protein (g/kg/day)
12 – 13	0.95
14 – 18	0.85
>18	0.8

- Protein recommendations extrapolated from adult values.
- These values are not intended for active/very active adolescents.
- Limited research has been conducted on adolescent athletes.

Protein Needs

Eur J Appl Physiol (2007) 100:27–33
DOI 10.1007/s00421-007-0400-4

ORIGINAL ARTICLE

Protein requirements in male adolescent soccer players

N. Boisseau · M. Vermorel · M. Rance · P. Duché · P. Patureau-Mirand

- Adolescent soccer players followed training 10-12 hours/week
- Living in a training center with all meals provided
- Followed three diets varying in protein amounts each for 12 days.
  - Diet 1: 1.4 g/kg
  - Diet 2: 1.2 g/kg
  - Diet 3: 1.0 g/kg

Significant positive protein nitrogen balance found with Diet 1: 1.4 g/kg
*Based on this study, Adolescent athletes have higher protein needs than non-active adolescents

Protein

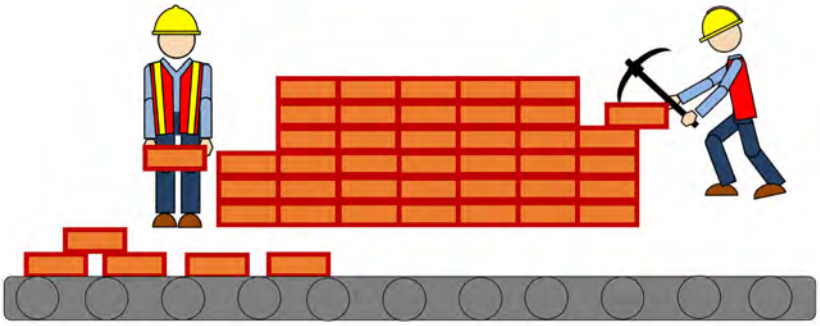
Protein recommendation of 1.4 g/kg body weight

150 lb athlete (68 kg)

Daily Protein Need: 95 grams/day

20-25 g protein per meal	Two snacks containing 15-20 g protein

Protein



Energy Requirements of Male Academy Soccer Players from the English Premier League

Marcus P. Hannon[1,2], Lloyd J. F. Parker[1,2], Daniel J. Carney[1], John McKeown[2], John R. Speakman[3], Catherine Hambly[3], Barry Drust[1], Viswanath B. Unnithan[4], Graeme L. Close[1,2], James P. Morton[1]

- 24 male soccer players from English Premier League soccer academy
- Ages 12-18 years
- Energy expenditure using doubly labeled water (DLW) and resting metabolic rate were measured over 14 days during 2018/19 season

U18 Energy Expenditure: 3586±487 kcal/day
U15 Energy Expenditure: 3029±262 kcal/day
U12/13 Energy Expenditure: 2859±265 kcal/day

U18 Energy Intake: 3180±279 kcal/day
U15 Energy Intake: 2821±338 kcal/day
U 12/13 Energy Intake: 2659±187 kcal/day

Are professional young rugby league players eating enough? Energy intake, expenditure and balance during a pre-season

Nessan Costello, Kevin Deighton, Thomas Preston, Jamie Matu, Joshua Rowe & Ben Jones

- 6 professional young rugby players ages 16-18y
- Energy expenditure using doubly labeled water (DLW) and resting metabolic rate were measured over 14 days during pre-season

Average Energy Expenditure: 4,388 kcal/day
Average Energy Intake: 4,000 kcal/day

Costello, 2018

Total Energy Expenditure Assessment in Elite Junior Basketball Players: A Validation Study Using Doubly Labeled Water

Analiza Silva;Diana Santos;Catarina Matias;Cláudia Minderico;Dale Schoeller;Luís Sardinha;

- 19 elite Portuguese basketball players, ages 16-18y (12 boys, 7 girls)
- Measured energy intake and energy expenditure using DLW mid-season
- Energy intake was self-reported and athletes under-reported

Boys:
Energy Expenditure: 4621 kcal/day
Energy Intake: 2694 kcal/day

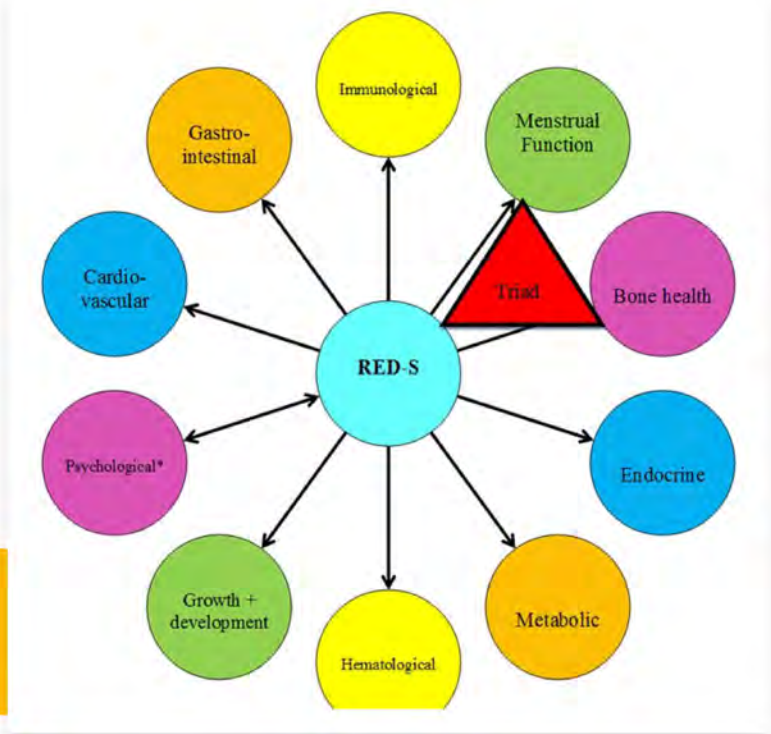
Girls:
Expenditure: 3495 kcal/day
Energy Intake: 1805 kcal/day

Low-Energy Availability

- Low-Energy Availability (LEA)
  - Inadequate energy to support functions required by the body to maintain optimal health and performance
- Relative Energy Deficiency in Sport (RED-S)
  - The impaired physiological function caused by low-energy availability.

Low Energy Availability = Calories Left After Exercise < Energy Cost of Physiological Functions

Mountjoy, 2018



Low-Energy Availability Consequences

(De Souza MJ, 2014)

Mountjoy, 2018
https://bjsm.bmj.com/content/52/11/687

Low-Energy Availability Performance consequences

Mountjoy, 2018
https://bjsm.bmj.com/content/52/11/687

Low-Energy Availability Potential Culprits

- High energy expenditure from training load and growing
- Picky eating habits
- Poor appetite
- Meal skipping
- Restrictive diet
- Intentional weight loss
- Poor time management

Increasing Energy Availability

- Strategies
  - Education
  - Non-water beverage with meals
  - Flavored milks
  - Energy dense foods, low-volume, high calorie
  - Setting a meal/snack schedule
  - Evening high calorie shake

Common Nutrition Challenges of High School Athletes

Common Challenges

- Difficulty meeting energy needs
- Meal timing
- Poor appetite
- Poor diet/Selective eating habits
- Injury prevention and recovery
- Weight pressures/Environmental pressures
- Interest in supplements
- Low-energy availability
- Following fad diets
- Physiological changes
- Socioeconomic constraints
- New added challenge of Covid-19

Difficulty Meeting Energy Needs

Causes

- High Energy Expenditure
- Multiple training sessions/day
- Growth
- Increased needs for muscle building

The Issue

At risk of low-energy availability

Increased risk of deficiencies, stunted growth, poor performance, burnout

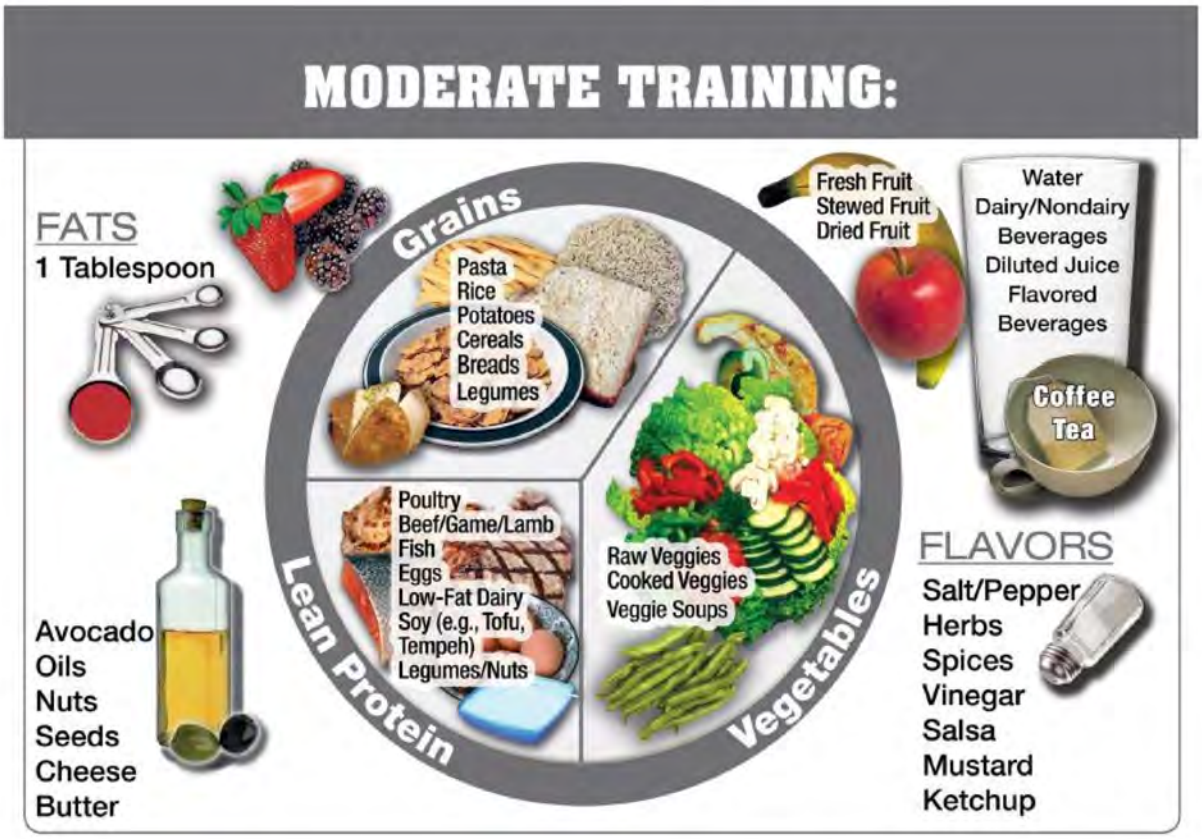
Difficulty Meeting Energy Needs

Education

Strategies to Add calories:

- Non-water beverage with meals
- Flavored milks
- Energy dense foods, low-volume, high calorie
- Evening high calorie shake

Following meal/snack schedule


MODERATE TRAINING:
FATS
1 Tablespoon
Avocado
Oils
Nuts
Seeds
Cheese
Butter
Grains
Pasta
Rice
Potatoes
Cereals
Breads
Legumes
Lean Protein
Poultry
Beef/Game/Lamb
Fish
Eggs
Low-Fat Dairy
Soy (e.g., Tofu, Tempeh)
Legumes/Nuts
Vegetables
Raw Veggies
Cooked Veggies
Veggie Soups
Fresh Fruit
Stewed Fruit
Dried Fruit
Water
Dairy/Nondairy
Beverages
Diluted Juice
Flavored
Beverages
Coffee
Tea
FLAVORS
Salt/Pepper
Herbs
Spices
Vinegar
Salsa
Mustard
Ketchup

HARD TRAINING / RACE DAY:
FATS
2 Tablespoons
Avocado
Oils
Nuts
Seeds
Cheese
Butter
Grains
Pasta
Rice
Potatoes
Cereals
Breads
Lean Protein
Poultry
Beef/Game/Lamb
Fish
Eggs
Low-Fat Dairy
Soy (e.g., Tofu, Tempeh)
Legumes/Nuts
Vegetables
Cooked Veggies
Veggie Soups
Raw Veggies
Fresh Fruit
Stewed Fruit
Dried Fruit
Water
Dairy/Nondairy
Beverages
Diluted Juice
Flavored
Beverages
Coffee
Tea
FLAVORS
Salt/Pepper
Herbs
Spices
Vinegar
Salsa
Mustard
Ketchup

Selective Eating Habits

Causes	The Issue
Not willing to try new foods	Difficulty meeting vitamin & mineral needs
Lack of cooking with variety of ingredients at home	Poor recovery
Lack of exposure to new foods	Typically high carb, processed foods and can lead to health risks
Underlying food sensory or medical issue	Lack of fiber rich foods (fruits and vegetables)

Selective Eating Habits

Solutions

- Cooking demos
- Structured meal/snacks
- Role-modeling
- Include teen
- Limit discussion of food choices during mealtime

Feed Succeed

Poor Appetite

Causes

- Stress/nerves
- Poor sleep
- Medication

The Issue

- Low-energy availability
- Vitamin deficiencies
- Unintentional weight loss

Poor Appetite

Solutions

- Low-volume high calorie foods
- Set a meal/snack/sleep schedule
- Time and stress management

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Meal Skipping

Causes

- On the go
- Prefers extra sleep
- Lack of knowledge
- Poor appetite

The Issue

- Low-energy availability
- Missing an opportunity to refuel

Meal Skipping

Solutions

- Pack breakfast night before
- Batch cooking
- Emergency snacks in car and backpack
- Eat something, even if it isn't the healthiest option
- Find out why it is happening
- Team budget to offer snacks if needed
- Team plate challenge – send in pictures of their "winning plate"

Restricted Diet

Causes

- Medical condition
- Media pressures
- Lack of knowledge
- Disordered eating

The Issue

- Could lead to disordered eating
- Red flag if eliminating an entire food group
- Low-energy availability
- Bone health

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Restricted Diet

- Probing their "why" and how they learned of the diet
- Educating on risks
- Discuss alternatives
- Refer to RD to help with planning

Weight Loss

Causes

- Sport performance
- Disordered eating/eating disorder
- Weight pressures from media
- Injury

The Issue

- Low-energy availability
- Loss of lean body mass
- Increased injury risk
- Dehydration
- Slow injury recovery

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Weight Loss

Language	Educate on appropriate language when referring to weight
Body Image	Facilitate positive body image
Support	Refer to school counselor and notify parents
Refer	If weight loss would benefit health outcomes, refer to RD
Educate	Educate on appropriate dietary changes for injury or reducing body fat

Supplements

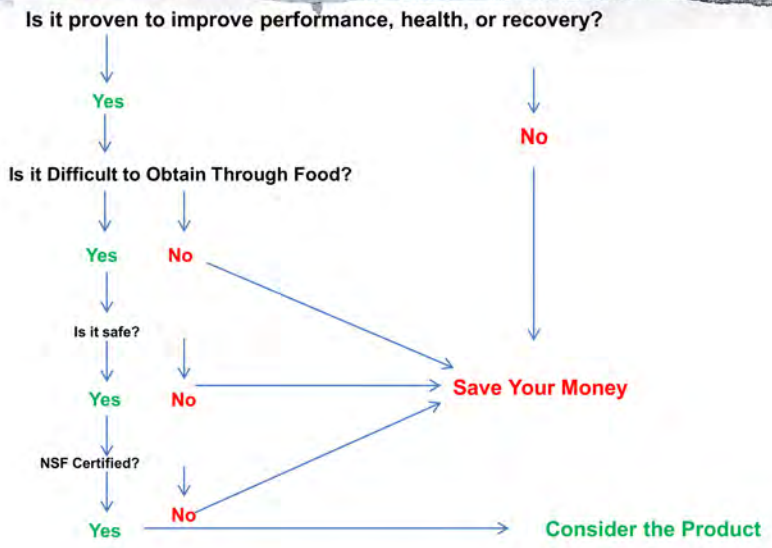
Causes

- Performance goals
- Teammate peer pressures
- Great marketing – false claims
- Role models/athlete influence
- Poor eating habits
- Excessive activity
  - Calorie output>calorie input
- Pressure to win
- Potential college scholarship
- Competitive edge
- Physique/appearance

The Issue

- Health risks
- Contamination with banned substances
- Diet quality
- Can accomplish same goal with food alone

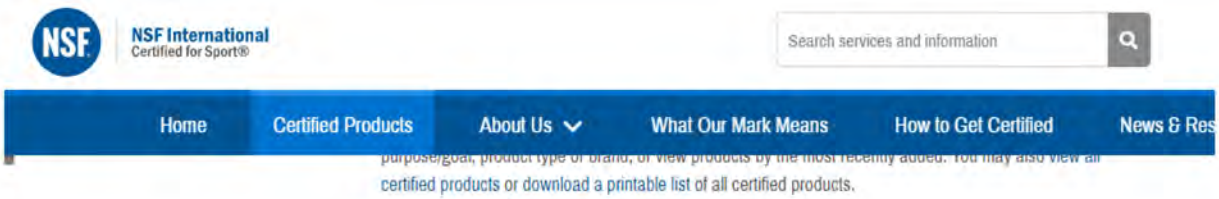
Supplements



Adapted from Graeme Close
@close_nutrition;
closenutrition.com

Supplements

- NSF Certified for Sport: www.nsfsport.com
- World Anti-Doping Agency: www.wada-ama.org
- Informed Sport http://www.informed-sport.com/
- United States Pharmacopeia: www.usp.org/USPverified
- Informed Choice: www.informed-choice.org
- BSCG: https://www.bscg.org/
- Drug Free Sport International: https://www.drugfreesport.com/



Challenges	Causes	The Issue	Solutions
High Energy Expenditure – difficulty meeting needs	• Multiple training sessions/day • Growth • Goal to increase muscle	• At risk of low-energy availability • Increased risk of deficiencies, stunted growth, poor performance, burnout	• Education to promote awareness • Meal/Snack Timing Schedule • Incorporate energy-dense, low-volume foods
Selective Eating Habits	• Not willing to try new foods • Lack of cooking with variety of ingredients at home • Lack of exposure to new foods • Underlying food sensory or medical issue	• Difficulty meeting vitamin & mineral needs • Poor recovery • Typically high carb, processed foods and can lead to health risks • Lack of fiber rich foods (fruits and vegetables)	• Cooking demos • Structured meal/snacks to promote hunger • Role-modeling • Include teen in helping prep meals and grocery lists • Limit discussion of food choices during mealtime
Poor Appetite	• Stress/nerves • Poor sleep • Medication	• Low-energy availability • Vitamin deficiencies	• Low-volume high calorie foods • Set a meal/snack/sleep schedule • Time and stress management
Meal Skipping	• On the go • Prefers extra sleep • Lack of knowledge • Poor appetite	• Low-energy availability • Missing an opportunity to refuel	• Pack breakfast night before • Batch cooking • Emergency snacks in car and backpack • Doesn't have to be the healthiest option, focus on palatable options when establishing habit
Restrictive Diet	• Medical condition • Media pressures • Lack of knowledge • Disordered eating	• Could lead to disordered eating • Red flag if eliminating an entire food group • Low-energy availability • Bone health	• Probing their "why" and how they learned of the diet • Educating on risks • Discuss alternatives • Refer to RD to help with planning
Weight Loss	• Sport performance • Disordered eating/eating disorder • Weight pressures from media/society • Injury	• Low-energy availability • Loss of lean body mass • Increased injury risk • Dehydration • Slow injury recovery	• Educate on appropriate language when referring to weight • Facilitate positive body image • Refer to school counselor and notify parents • If weight loss would benefit health outcomes, refer to RD • Educate on appropriate dietary changes for

When to Refer

- Injured athletes at nutrition risk
- Injury prone athletes
- Support with weight goals
- Performance plateau
- Disordered Eating
- Gastrointestinal issues
- Low-Energy Availability
- New medical diagnosis

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Questions to Ask

1. How many meals are you having each day? (🚩 1-2 meals per day)
2. Do you restrict any foods or food groups? (🚩 if yes)
3. How many fruits and vegetables are you eating/day? (🚩 1 or less per day)
4. How often do you drink milk or eat yogurt or cheese? (🚩 1 or less per day)
5. How often are you eating fast food meals? (🚩 fast food 5+/wk)
6. Are you currently consuming a supplement for performance? (🚩 if yes)

Resources

- NSF for Sport app
- Performancepartner.Gatorade.com > Resources
- Sportsrd.org/downloadable-resources/
- incredibleegg.org/nutrition/nutrition-education-materials/
- Foodandnutrition.org
- Eatright.org
- Teamusa.org/nutrition
- Podcasts! “We do Science” and “Signma nutrition”

FUELING
DURING EXERCISE

- Stay well-fueled during workouts with the right mix and timing of **carbohydrates**, **fluids** and **electrolytes** to replace what's lost during exercise.
- Take small, frequent bites during exercise and always with fluids.
- Experiment with new foods and drinks during training to find what works best for competition.

C·P·S·D·A NDC NATIONAL DAIRY COUNCIL

For advice on customizing a nutrition plan, consult a sports dietitian.

EXERCISE TIME	TYPE OF EXERCISE	HOW TO FUEL
BRIEF EXERCISE		
<45 MINUTES	• Batting practice • Shoot around (basketball) • Lifting	Focus on water for hydration
SUSTAINED HIGH-ENERGY EXERCISE		
45-75 MINUTES	• Cross country workout • Stop-and-start sports (soccer, football, field hockey)	Small amounts of carbs throughout activity (i.e., 2-3 gulps of sports fluid or 1/2 serving of applesauce every 15-20 min.)
ENDURANCE EXERCISE		
1-2.5 HOURS	• Long distance cross country race • Stop-and-start sports (soccer, football, field hockey) • Rowing workouts	30-60 g carbs/hour (i.e., 1-2 handfuls of raisins or 1-2 med banana)

I DON'T WANT TO BOTHER WITH EATING AFTER A GAME, I'M TOO BUSY SEEING MY FRIENDS AND FAMILY IN THE STANDS. WHY CAN'T I JUST WAIT UNTIL I GET TO A MEAL? I'LL EAT EVENTUALLY.

The meal you'll eat with your family or friends is important to your recovery. But so are the nutrients you take in after the game, which act as a bridge to that meal. While your body is still warmed up from the game, your muscles are more effective at using the nutrients than if you wait. Since you have practice again tomorrow, eating a snack right after the game will help your muscles be ready. So grab a shake or a bar with some water while you're getting dressed, then go have fun with your fans.

OK, I'M IN. WHAT DO I NEED TO EAT FOR RECOVERY?

Rehydrate – drink water or sports drink

Replenish – eat carbohydrate

Rebuild – eat protein

PRACTICE GOOD RECOVERY

You just finished a hard afternoon practice.

While you're changing after practice, eat that recovery bar you remembered to put in your bag with some water.

Dietitian Interventions

Dietitian Interventions

- Team/Group Education
- Parent Education
- Individual Counseling
- Social Media
- Pre-Game Meal Planning
- Education Materials
- Coaches Meetings
- Game Attendance

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Team Specific Curriculum

Start with basics and build on

30-45 minute sessions with activity

- Jeopardy
- Nutrition Jenga
- Pick your plate
- Nutrition-ary
- Open formum discussions
- Partner activities
- Cooking Demos

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Team Specific Curriculum

Example Football Curriculum

Macronutrients and portion sizing	Weight gain basics 1	Weight gain basics 2	Pre-fueling	Recovery	Hydration	Supplementation	Cooking Demo

Example Volleyball Curriculum

Macronutrients and portion sizing	Pre-fueling	Recovery	Signs/symptoms of under fueling	Meal planning for tournaments	Open forum discussion and Goal Setting	Cooking Demo

Types of Interactions

- Small Group
  - 3-5 students
  - Create specific goals for each athlete
  - More conducive to Q&A than larger group presentation
- One-on-One
  - Before/after school or during lunch
  - 24 hour recall and nutrition basics review
  - Set 2-3 individualized goals
  - Send notes write up to athlete, trainer, coach (with permission) and parent
- Evening talks
  - Parents and students
  - Coordinated with booster club meetings
- Social Media
  - Twitter
  - Infographics

What Works Well

- Consistent communication with AT
- Frequent visits to build trust with students
- Short presentations on one topic
  - Building on previous lesson each week
- Activities to enhance learning
- Goal setting
  - Follow-up meetings on goal progress
- Parent presentations
- Having 1-2 coaches who fully engage and participate

Coach Feedback

- I believe this is a tremendous asset to my wrestlers
- The breakdown for our regional/state tournament. This was super helpful for the girls.
- XC – learning to eat before practice and competition; eating enough! Track – learning to put good fuel in their bodies
- Focus on Nutrition and Supplements was very helpful. Also I saw a lot of our athletes giving more thought to pre-game and post-game meals
- The athletes were able to benefit from the Q&A when the dietitian talked to the team.
- The athletes were able to gain a better understanding of what to eat prior to match/tournament and how to keep their body fueled properly throughout the week

Athlete Feedback

- Started to eat breakfast everyday
- Started eating more home cooked meals along with eating more meals and better portions
- Drinking more water throughout the day, incorporating more carbohydrates at each meal and making sure I get the recommended 8 hours of sleep each night.
- Pay attention to what I eat for recovery after I workout.
- More carbs before working out, and more snacks throughout the day to give me energy
- Less fast food, added healthier things as snacks
- Eating before practice, drinking more water, more protein after workouts
- Less junk food and snack more regularly and fuel my body for exercise better
- Balancing my plate by filling it with the right amount of protein, carbs, fat, etc.

Summary

Sports dietitians play a key role within the sports medicine team throughout adolescence.

High school athletes face nutrition challenges, which can be overcome by:

- Nutrition education on the risks and benefits of adequately fueling
- Look for the signs, symptoms, and utilize the provided screening questions when working with your athletes
- Utilize your nutrition resources
- Referral to sports dietitian

Increasing energy to support activity and growth combined with adequate protein, calcium, and iron may support high school athletes' growth and performance.

Thank You

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