

Youth Athletes

Nourishing Young Bodies and Minds

Christine Rosenbloom, PhD, RDN, CSSD, FAND

Youth participation in individual and team sports is high, yet little is known about the nutritional needs of children or adolescents who compete in sports. Parents and volunteer coaches are responsible for nutrition and hydration advice for youth athletes and it can be woefully incorrect. There are no predictive equations for energy needs, and research on protein intake for muscle growth and repair is conducted on adults. Currently, the best we can do is adapt nutrition guidelines for adults to young athletes, using growth and development as a guide for monitoring success with the implementation of nutrition strategies. Hydration strategies are critical for young athletes as heat illnesses occur more frequently in this group compared with adults. Young athletes are not immune to messages on enhancing muscle development, and use of performance-enhancing substances is higher than previously thought. Strategies for nutrition education for young athletes are included, based on psychosocial development. *Nutr Today*. 2016;51(5):221–227

The benefits of participation in sport at an early age are many. Among them are the following:

- Physical health
 - Weight control
 - Bone health
 - Muscular development
 - Reduced risk of high blood pressure
 - Positive influence on blood lipids
- Mental health
 - Improved self-esteem
 - Improved cognitive skills
- Social skills
 - Development of leadership qualities
 - Ability to set goals
 - Achievement in school
 - Increased likelihood of attending college⁴

Project Play from the Aspen Institute also reports that childhood sports participation is good predictor of adult athletic participation.⁴

Although there are many benefits, there are some concerns with youth sports participation. It can be costly; participation fees, uniforms, travel teams, and providing nourishment can fall to the parents. Increasingly, parents are concerned about injury, from the usual muscle strains to the more serious joint ligament tears necessitating surgery and head injuries that could set the stage for cognitive impairment later in life. The quality and behavior of volunteer coaches are also a concern, as well as the time commitment to chauffeur kids to practice and games. Lastly, some children drop out of sports when it is no longer fun. When winning overtakes fun, participation rates fall.

YOUTH ATHLETIC DEVELOPMENT

The IOC evaluated the science and practice of developing young athletes with the following goal: “Develop, healthy, capable and resilient young athletes, while attaining widespread, inclusive, sustainable and enjoyable participation and success for all levels of individual athletic achievement.”^{5(p1)} Nutrition is a key component of athletic development. Unfortunately, we have scant literature on the nutrition needs of young athletes owing to the inherent difficulties of conducting research on children and adolescents. Most of the nutrition recommendations are extrapolated from research on adults and then filtered through the lens of national dietary recommendations for younger

It is estimated that 45 million children and adolescents participate in sports in the United States.¹ The National Federation of State High School Associations reports that over 7 million youth compete in high school sports.² Interest in youth sports is so great that the International Olympic Committee (IOC) developed the Youth Olympic Games, an elite, global sporting event modeled on the Olympic Games. The inaugural event was held in 2010 and is held every 4 years, like the Olympics. Designed for 15- to 18-year-old adolescents, more than 3500 youth participate in the summer games and more than 1100 in the winter games. The goal is to highlight elite youth sports participation along with a cultural and education program.³

Christine Rosenbloom, PhD, RDN, CSSD, FAND, is professor emerita of nutrition at Georgia State University. She currently consults with athletes of all ages through her business, Chris Rosenbloom Food and Nutrition Services, LLC. She is editor-in-chief of *Sports Nutrition: A Practice Manual for Professionals* (5th ed, 2012), published by the Academy of Nutrition and Dietetics and a regular contributor to *USA Swimming*.

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Correspondence: Christine Rosenbloom, PhD, RDN, CSSD, FAND, 179 Honeysuckle Lane, Hartwell, GA 30643 (chrisrosenbloom@gmail.com).

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age groups. Other challenges include providing age- and maturity-stage-appropriate nutrition interventions. Although we lump “youth” or “adolescent” athletes together, they are very different depending on the stages of physical and mental development.

The International Olympic Committee (IOC) consensus statement on youth development identifies nutrition as a key component.

PHYSICAL DEVELOPMENT

Puberty is characterized by physical and psychological changes. Increases in height, weight, bone mass and density, along with changes in body composition are consistent between both genders, but the timing and rate of change vary greatly.⁵ Therefore, age is not a greater marker of puberty. Figure 1 shows 2 young athletes, both age 12 but obviously the girl is more physically developed



FIGURE 1. 12-year old youth athletes.

than the boy is. There is no gold standard to assess physical maturity for young athletes⁶ despite the desire for one. Coaches and national sports organizations are always on the lookout for the next Olympic gold medalist, and this has led to an entire industry designed to identify and train young athletes.⁵ Tanner Stages of Development, also known as Sexual Maturity Ratings,⁷ rate growth and development in 5 stages, from prepubertal children (Stage 1) to full maturity (Stage 5). Tanner stages may be helpful in designing nutrition strategies, but even when access to preparticipation physicals are available, Tanner staging may not be included in a physician’s assessment of youth. Puberty and adolescent growth spurts usually occur between 9 and 15 years and athletic performance improves with physical maturity.⁵ However, some well-meaning parents and coaches try to hasten development in strength and speed of young athletes by pushing protein and dietary supplements. Recently, the author was asked by the parent of a 7-year-old how much creatine his son should take to increase his ability to strength train to gain muscle mass. The answer is none. Some sports dietitians fear that encouraging high protein and calorie intakes in athletes before they have reached puberty could contribute to excess fat storage and the risk for overweight/obesity.

PSYCHOSOCIAL DEVELOPMENT

It is clear that children and adolescents are not mini-adults. As children are physically maturing, they are also developing mentally and socially. Understanding the developmental changes can help the sports dietitian hone nutrition education messages when dealing with children and adolescents. Table 1 identifies some of the emotional, social, and cognitive changes in 3 different age groups.⁸

Younger children tend to be concrete thinkers, seeing things as good or bad, black or white. Nutrition education strategies that are direct and specific can help younger athletes. For example, an 11-year-old female softball player was asked if there were any foods or beverages that she did not consume. She responded that she tried not eat “junk food” or “sugar-sweetened soft drinks.” She explained that “sugar was bad for athletes.” When asked what she did drink, she replied “sweet tea and lemonade.” She was not able to translate her knowledge that sugar is in soft drinks but also in sweetened tea or lemonade. It would be more helpful to identify healthful beverages and list all less healthful choices instead of relying on a young athlete to understand that sugar containing beverages include more than just soft drinks.

Older athletes can think more abstractly, so nutrition education strategies for this group can include general

TABLE 1 Psychosocial Changes in Young Athletes⁸

Ages	Social and Emotional	Cognitive
6–8 y	Beginning to show independence from family	Rapid development of cognitive skills
	Understanding place in the world	Developing language skills
	Relate to friends and teammates	Developing empathy
	Desire for acceptance	Concrete thinking
9–11 y	Form strong friendships	Concrete thinking
	Responds to peer pressure	Increasing attention span
	Body image awareness	Increasing empathy for others
12–14 y	Increasing body image awareness	More complex thought
	Can develop disordered eating	Able to verbalize feelings
	Moodiness	Strong sense of right and wrong
	Rude and short tempered with family	More abstract thinking
	Heavily influenced by peers	
15–18 y	More interest in sexual relationships	Develop work ethic
	Independent	Show concern for the future
	Deeper caring	Able to give reasons for choices
	Desire to understand “why?”	Know right from wrong
	See themselves as “bullet proof”	

tips that they can apply to the big picture. In these age groups, body image issues and disordered eating can begin to take root. Some girls pursue thinness and boys seek increased muscularity. Pressure from coaches or parents to lose or gain weight can compound the problem. Some young athletes think that a lower body weight will equate to better sports performance when the end result might be poorer sports performance from being underfueled for training and competition. Compounding body image issues can be the uniforms that athletes, especially girls, wear for competition. Tight, spandex

shorts (dubbed “bun huggers” by the athletes who have to wear them) and sports bra-like tops, show everything, so it is not surprising that some girls seek thinness when their bodies are on display in a tight, skimpy uniform.

ENERGY AND MACRONUTRIENT RECOMMENDATIONS

A position paper from the Sports Dietitians of Australia on sports nutrition for the adolescent athlete provides a comprehensive literature review of energy, macronutrient, and micronutrient needs.⁹ There are no predictive equations to estimate energy needs for fueling sports performance, normal growth and development must also be considered. Using national standards, such as growth charts from the Centers for Disease Control and Prevention,¹⁰ can be used to assess normal growth to monitor energy intake.

The concept of energy availability, as opposed to energy balance, is a useful concept for young athletes, especially for those going through puberty.⁹ Energy availability focuses on having enough energy (calories) available for normal growth and development after accounting for energy needed for sports training. Athletes who have long periods of low energy availability increase their risk of injury, delayed growth, poor bone health, depressed immune function, depressed protein synthesis, and menstrual irregularities in female athletes.^{9,11} The term *relative energy deficiency syndrome* is used to describe this condition and can be applied to both male and female athletes. Although separate from the female athlete triad, low energy availability can be the first step toward developing disordered eating in female athletes.¹¹ On the flip side, consuming too many calories can set the stage for overweight and obesity. Although athletes may have lower rates of obesity, they are not immune to storing excess body fat.

There are no specific guidelines for distributing energy among carbohydrate, protein, and fat for young athletes, and there is no reason to think that the guidelines used for adults cannot be used to guide recommendations for young athletes.^{9,12} Carbohydrate recommendations for athletes have evolved to consider carbohydrate availability to ensure that sufficient carbohydrate is consumed to support training and competition.¹² Young recreational athletes (weekend soccer players) need less carbohydrate than do those who seriously compete and have regular practice sessions and competitions. Adjusting carbohydrate intake for training duration and intensity, in addition to normal growth and development, is a good practice. Specific carbohydrate recommendations are found in the 2016 Position Paper on Nutrition and Athletic Performance,¹² but practical tips for carbohydrate consumption for young athletes include the following:

- Encouraging nutrient-rich carbohydrates eaten throughout the day
- Eating breakfast before practice
- Focusing on carbohydrates in whole grains, fruits, vegetables, and dairy foods with less intake from refined grains and foods and beverages with added sugars
- Recognizing that carbohydrate-rich foods are preferred instead of sports foods or supplements.

Protein recommendations for youth take growth and development into account, but no research has been conducted on specific protein requirements for athletic youth. Therefore, it is prudent to use the same protein recommendations used for adult athletes, which is 1.2 to 2.0 g/kg/body weight.¹² Spreading protein intake equally across meals is a good strategy for young athletes. Adolescent athletes who begin to strength train a couple of times a week will also benefit from 20 g of high-quality protein eaten shortly after weight training session. There is no need for protein powders or supplements in children or adolescent athletes. For those adolescent athletes desiring weight gain, remind them that ingesting excess protein will not push protein into muscles, resulting in increased muscle mass; protein can only be pulled into muscle with weight training. Dietary fat is a nutrient that can be shunned by athletes as a weight control measure, or totally ignored and consumed in excess through consumption of burgers, fries, pizza, and chicken strips (which is all too frequently the mainstay of teenage high school athletes). Using the guidelines for macronutrient distribution range, fat intake in the range of 25% to 35% of calories for 9- to 18-year-old boys and girls and 20% to 25% for those older than 18 years is recommended.¹³

There is limited information to assess how well young athletes meet macronutrient targets, but a dietitian-observed study on dietary intake lends some insight.¹⁴ For a 24-hour period, 29 competitive athletes (22 male and 7 female; ages 14 to 19 years) were observed by dietitians as the young athletes trained at a sports academy in skill and team sports. Both male and female athletes failed to eat sufficient carbohydrate during exercise (30–60 g) and female athletes did not meet the minimum recommendations for carbohydrate intake during the 24-hour observations period or the carbohydrate and protein recommendations post exercise. The male athletes over-consumed protein before, during, and after exercise.¹⁴ Although the authors acknowledge the limitations of a 24-hour evaluation period for dietary intake, this unique study does not rely on food records or food frequency data, which are a source of error in many dietary studies.

HYDRATION ISSUES

Approximately two-thirds of children are significantly dehydrated before sports practice.¹⁵ Heat illnesses are more prevalent in young athletes than in adults and is the leading cause of death among high school athletes.¹⁶

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For years, it was thought that youth are at greater risk for heat illnesses than adults are because children and adolescents are less effective in regulating body temperature, therefore incurring greater strain on the cardiovascular system.¹⁷ However, more recent studies indicate that children and adults have similar rectal and skin temperatures, cardiovascular responses, and exercise-tolerance time during exercise in the heat.^{17,18} What does differ is the way that young athletes dissipate heat; youth rely less on sweating or evaporate cooling and more on redistributing blood flow or conductive and radiative cooling, compared with adults. This tells us that youth athletes can train and compete in the heat even though they do have greater incidence of heat illnesses. Behavioral factors are most likely the greatest contributor to heat illnesses in young athletes.^{9,15} Children are more likely to be caught up in social and environmental distractors when playing sports.¹⁵ If you have ever watched a child playing a game on a hot summer day, you have probably noticed that they do not keep a water bottle within easy reach or stop to take frequent fluid breaks. In addition, high school athletes who compete in football wear uniforms and protective equipment that can make them a human sweat box. The American Academy of Pediatrics recommends the following guidelines for hydration for youth involved in sports:

- For 9- to 12-year-olds, 100 to 250 mL (3-8 oz) of fluids every 20 minutes of activity
- For 13- to 18-year-olds, 1 to 1.5 L (34–50 oz) of fluids every 60 minutes of activity¹⁷

The choice of fluid generates controversy; water is the logical choice. Children have lower sweat sodium losses than adults do, so there is not as great a need to replace electrolytes.⁹ However, high school athletes who exercise in hot, humid conditions (football, soccer, lacrosse, tennis, distance running, and sand volleyball) may benefit from consuming sports drinks to provide carbohydrates and electrolytes. Sports drinks should not be confused with caffeinated energy drinks; children and adolescent athletes should not consume energy drinks for fluid replacement.

MICRONUTRIENT RECOMMENDATIONS

The IOC consensus statement on youth athletic development mentions 3 micronutrients of concern for young athletes: calcium, vitamin D, and iron.⁵ Adolescent athletes need higher intakes of calcium (1300 mg/d) to support

bone growth; 80% to 90% of peak bone mass is accrued by the end of puberty, making adequate intakes of calcium and vitamin D critical to bone health.^{19,20} Both girls and boys in the age range of 9 to 13 years and girls aged 14 to 18 years have a high prevalence (>50%) of inadequate calcium intake.²¹ Athletes who restrict energy intake, avoid dairy foods, and have disordered eating patterns are at risk for low calcium intakes.¹² Helping young athletes incorporate calcium-rich foods in their diet is the first step in ensuring adequate intake. Foods that might appeal to young athletes include squeeze tubes of yogurt, smoothies or milkshakes made with yogurt or milk (dairy, soy, or almond milk), macaroni and cheese, grilled cheese sandwiches, broccoli, calcium-fortified orange juice, and ready-to-eat breakfast cereals.

Less is known about vitamin D intake in young athletes. Young athletes at greatest risk for insufficient vitamin D include those who train mostly indoors (gymnasts, figure skaters, etc), those who live latitudes greater than 35°, and those who use sun block from head to toe when outdoors.⁹ Vitamin D–fortified dairy products can help this population get adequate intakes of both bone-building nutrients, but not all dairy foods are fortified with vitamin D. Yogurt and ice cream, 2 popular foods with young athletes, may not contain added vitamin D, so parents are encouraged to look for brands that contain vitamin D.

Iron deficiency anemia is a widespread disorder and among athletes, iron deficiency without anemia is also a concern. It is estimated that 9% to 10% of adolescent girls and 1% of boys have iron deficiency without anemia, with higher frequency in runners, swimmers, rowers, soccer, and basketball players.²² While most young athletes will not have laboratory values indicating anemia, those at risk include female and vegetarian athletes and/or those who consume low protein intakes. Young athletes who complain of excessive fatigue with little motivation or energy to complete practice should be questioned about dietary iron intake.

DIETARY SUPPLEMENT AND SPORT FOOD USE

Supplement use might be higher in youth than previously thought. Eisenberg and colleagues²³ analyzed data from the Eating and Activity in Teens survey of middle and high school students in 20 public schools in Minneapolis and St. Paul. The average age of those surveyed was 14.4 years, and the participants were equally divided by gender. Five muscle-enhancing behaviors were assessed in the survey to determine strategies used by youth to build and maintain muscle mass:

- Changed eating behaviors
- Exercised more
- Used protein powders or shakes

- Used steroids
- Used other muscle-building substances (such as creatine, amino acids, hydroxyl methylbutyrate, dehydroepiandrosterone, or growth hormone).

Muscle-enhancing behaviors were common among both boys and girls. About 60% reported changing eating habits and more than 90% said they exercised to build muscle. Among the boys, 35% reported using protein powders or shakes, 6% for using steroids, and 10% for using other muscle-building supplements. For girls, 21% used protein supplements, 5% reported steroid use, and 6% reported other muscle-building substances.²³

Use of performance-enhancing substances is higher in athletes than nonathletes, but both groups are using dietary supplements to improve appearance, not just athletic ability.²⁴ Those at higher risk of using performance-enhancing supplements include young athletes with body dissatisfaction, higher body mass index, training in a commercial gym, exposure to appearance-oriented media images, and use of alcohol or drugs.²⁴ Because these substances are sold over-the-counter, many parents and young athletes may not be aware that the Food and Drug Administration does not test these products for safety or efficacy. A useful resource for parents and coaches is the Taylor Hooten Foundation, an organization with the mission to educate youth about performance-enhancing substances. The Web site is listed in Table 2.

Use of sports foods, often fortified with creatine, caffeine, or other substances, is also on the rise with young athletes. Sports foods and supplement companies target young athletes with messages to improve appearance and performance.⁹ Here is a recent e-mail from a swim coach to the author:

I'm a swim coach who is responsible for training kids between the ages of 9–12 of all different abilities. While I take more traditional approach in how athletes should fuel for training and competition (i.e., real food), I see swimmers of this age resorting to the fast, convenient foods such as sports candies and sport snacks to fuel their body before competition. Many times they are devouring handfuls of sports jelly beans before getting on the blocks for a race. They get them from their parents with no instructions on how to use them or when to use them.

Sports foods might appear to be “better” than real foods to some young athletes, and they certainly are convenient. However, young athletes would be better served by eating foods that provide the nutrients needed for growth and development and less reliance on engineered sports foods. Jill Castle, registered dietitian and author of *Eat Like a Champion: Performance Nutrition for Your Young Athlete* (AMACOM, 2015), offers many tips on her website

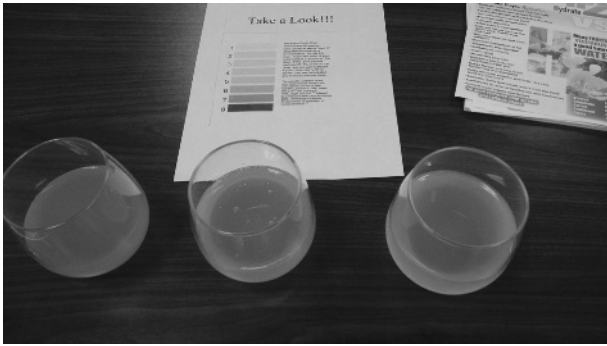


FIGURE 2. Visual assessment of hydration.

with downloadable handouts of pre-workout snacks appropriate for young athletes (Table 2).

NUTRITION EDUCATION FOR YOUNG ATHLETES

Drawing on personal experience, not evidence-based research, the author offers these tips for providing nutrition education to young athletes. Currently, the author is a volunteer sports dietitian for middle school and high school sports teams. Working with young and adolescent athletes reveals new challenges to providing nutrition. The district athletic director and coaches can help the sports dietitian understand the community culture and economic status of the children who participate in sport. The high school football coach had 3 simple rules for his players: “(1) Be on time, (2) Be where you are supposed to be, and (3) Act like you’ve got some sense.” Good advice for young athletes, and for life! Here are 6 tips for successful interactions with young athletes:

1. Keep it short. Aim for 5- to 10-minute mini-nutrition lessons before or after sports practice. For example, for the high school football team, the author sets up a nutrition station in the high school cafeteria after practice and right before a team dinner to engage the high school players on nutrition topics. The nutrition station is designed to deliver mini-lessons and to encourage young athletes to talk to the sports dietitian and ask questions that they might not feel comfortable asking in a group setting.
2. Make it visual. Use food models or real food to show athletes portion sizes, how much protein to consume after a workout, or how much carbohydrate to eat before a basketball game. Dietitians think in grams of protein or carbohydrate; athletes think of food, so showing them how much to eat helps them put the science into practice. A visual representation of urine color to assess hydration is always well received; using lemonade, apple juice, and mango-pineapple juice to represent urine color gets athletes talking. Figure 2 shows that demonstration.
3. Feed them. Most young athletes are always hungry. Use the mini-lessons to encourage them to try new foods. Make smoothies for tasting and provide the recipe, serve roasted cauliflower on toothpicks for a small bite, or try a peanut butter, chocolate, and crunchy cereal dessert bite. Many young athletes are resistant to trying new foods, but when



FIGURE 3. Vegetable platter “turkey.”

small bites are offered and other teammates are willing to try the food, most go along. It has been fun to watch a young athlete taste a new food for the first time and see a smile appear on his or her face when they like it.

4. Have fun (and feed them). For younger athletes, search Pinterest for fun food creations get them engaged and trying new foods. Figure 3 is photo of the author’s great niece helping to make a Thanksgiving vegetable “turkey” platter.
5. Use social media. Young athletes love to have their pictures posted on social media. Use social media to deliver nutrition messages to the coaches and team, along with photos of athletes eating healthy foods or hydrating during a game.
6. Focus less on performance and more on instilling sound nutrition habits for growth and development, and for life.

Useful resources for additional information on nutrition for young athletes are found in Table 2.

TABLE 2	Resources for Nutrition for Young Athletes
	Mom’s Team
	http://momsteam.com/
	The Taylor Hooten Foundation
	http://taylorhooten.org/
	United States Olympic Committee (Team USA) Sports Nutrition
	http://www.teamusa.org/About-the-USOC/Athlete-Development/Sport-Performance/Nutrition/Resources-and-Fact-Sheets
	USA Swimming Nutrition Center
	http://www.usaswimming.org/DesktopDefault.aspx?TabId=1546&Alias=Rainbow&Lang=en
	Jill Castle, America’s Childhood Nutrition Expert
	http://jillcastle.com/
	Meal Makeover Moms
	http://www.mealmakeovermoms.com/

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