More than 35 million youth, aged 5 to 18 years, in the United States play organized sports each year. It is widely recognized that nutrition is important to athletic performance. Today’s child and adolescent athletes are challenged to meet the nutrient needs for age- and gender-appropriate growth and development, attain and maintain appropriate body weight or body fat, prevent iron and vitamin D deficiencies, and stay well hydrated. Their nutrient needs vary depending on type of sport (endurance, strength and weight class sports, or team sports) and the type and intensity of training and competition. Surprisingly, data to guide recommendations for the child and adolescent athlete are not readily available to the parents, coaches, school nurses, school dietitians and food service workers and others who work with these athletes. Both the Academy of Nutrition and Dietetics and the American Academy of Pediatrics have handouts for coaches and parents about sports-related healthy eating and hydration. An increasing number of youth have a chronic disease and yet play sports, providing additional challenges to those giving them guidance on meeting nutritional needs. In this article, we review 2 cases from our Family Medicine Nutrition Clinic, highlighting some, but not all, the current nutrition issues faced by the growing athlete and healthcare providers. Special attention is given to youth who may have a chronic condition or experience weight loss.

CASE 1. YOUNG BASEBALL PLAYER

W.K. is a 10-year-old male child, diagnosed with Crohn’s disease (CD), who is very athletic and participates in baseball, football, and basketball. He is brought in by his mother to discuss nutrition for his active lifestyle. They have specific questions about dietary supplements and sports drinks that will help him maintain a healthy weight during sports seasons. Some of the older boys on the baseball team are using whey protein shakes after workouts and games and they want to know if this is a good way for W.K. to get the protein he needs. W.K. likes sports drinks and wonders what type he should use after practice or games.

Table 1 shows W.K.’s weight, height, and body mass index (BMI; kg/m²) history from age 5 years. When diagnosed with CD at age 7 years, his BMI was in the healthy range. He had iron deficiency anemia with hemoglobin level of...
8.7 g/dL and an erythrocyte sedimentation rate of 58. Initially, he was treated with lansoprazole (Prevacid; Takeda Pharmaceuticals, Deerfield, Illinois) 15 mg daily, iron (FeSO₄ 325 mg) daily for his profound anemia, and sulfasalazine (Azulfidine; Upjohn Co, Kalamazoo, Michigan) 500 mg 3 times per day. Several weeks later, he had lost some weight and his BMI plotted as underweight. He eventually gained some weight, but at age 8 years, his BMI still plotted as underweight. He experienced a CD flare, and at age 9 years, his BMI plotted in the healthy range. He was started on prednisone (Deltasone; Pharmacia Corp, Peapack, New Jersey) for 3 months and then transitioned to methotrexate (Trexall; Treva Pharmaceuticals, North Wales, Pennsylvania) 15 mg/wk along with 1 mg of folic acid while continuing the sulfasalazine (Azulfidine; Upjohn Co), iron, and vitamin D₂ (1000 mg, twice a day). He takes a store-brand multiple vitamin mineral dietary supplement. The lansoprazole (Prevacid; Takeda Pharmaceuticals) was stopped when he finished the prednisone (Deltasone; Pharmacia Corp). At his physician visit when he was 9 years 6 months old, he was plotted on the 33rd percentile of BMI and his vitamin D level was low (24 ng/dL), for which he took 1000 IU vitamin D₃ twice a day. After 3 months, his vitamin D level increased to only 27 ng/dL. He was switched to 2000 IU vitamin D₃ twice a day. At his 10-year-old well-child checkup with his primary physician, his weight had dropped and he plotted on the 23rd BMI percentile for age percentile. It became clear that he and his family needed dietary advice to maintaining good nutrition while engaged in sports. His BMI % for age 55 6 2 2 9 12 33 23 20

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CD in Youth

Crohn’s disease is a chronic, relapsing illness affecting the gastrointestinal (GI) tract. This condition complicates the advice that might be given to a healthy 10-year-old baseball player, and therefore, we will review some of those issues before discussing general nutritional advice for healthy young ball players. The etiology of CD remains unknown, although genetic susceptibility, environmental factors, and the role of intestinal microflora are likely to be important. Patients in their growing years are in a constant catabolic state and can experience severe malnutrition. Children with any type of inflammatory bowel disease experience impaired growth. For those with CD, it may be upward of 20% to 35%. Nutrient sufficiency is critical to maintain normal linear growth. The benefits of nutritional therapy have been demonstrated in positively addressing micronutrient deficiencies, poor weight gain, altered linear growth, and delayed puberty. Early satiety

Background

Organized Youth Baseball

Baseball is usually considered a low-energy expenditure sport. It requires fine motor control, coordination, and reaction time as well as anaerobic power and general fitness conditioning. For a 10-year-old baseball player in W.K.’s league, game day usually consists of 1.5 hours of pregame warm-up (fielding, hitting, throwing) and a 1.5- to 2-hour game. The season is usually 12 weeks long with 2 games per week and at least two 2-hour practices per week, all played locally. Older players may travel up to 2½ hours to game in another community and also may have double headers.
and/or discomfort from eating appear to be the major barriers to consuming sufficient calories. Many youth with CD experience low vitamin D, folic acid, zinc, and copper status from either poor dietary intake or malabsorption. A multivitamin mineral dietary supplement is typically prescribed. Additional supplementation is based on serum vitamin and trace element levels.

Many youth with CD experience low vitamin D, folic acid, zinc, and copper status from either poor dietary intake or malabsorption.

The current array of pharmaceutical drugs to treat CD induces clinical remission but have potential for long-term side effects. Diet has been described as both a major suspect in the list of possible environmental factors that negatively affect the disease as well as a possible solution. The role of sugar in the development as well as its elimination in the prevention of flares has been of interest for some time, although the evidence remains inconclusive. Early studies showed that in the months before the diagnosis of CD, patients had increased dietary intake of sugar, based on their diet recall, and further studies showed that people with CD continued their high consumption of sugars when compared with controls. It has been suggested that this behavior may be caused by impaired ability to taste sugar. Some research has tried to assess whether decreased sugar intake would result in fewer flare-ups of CD, but the results were mixed, with some showing improved symptoms during times of high disease activity but no difference in quiescent times and other studies showing relapse even on the low-sugar diet. Although the evidence is weak, this remains an active area of research and can be shared with parents because limiting sugar intake has many health benefits and should be considered in diet planning. Some parents and researchers are interested in alternative therapies, such as exclusion diets and use of nutraceuticals, that have been claimed to produce remission, correct growth failure, and prevent flares or relapses and have less potential for long-term toxicity. Researchers have recently suggested that nutritional therapy can improve the inflammatory status of CD by restoring the composition of the mucosal microbiome.

Omega-3 Fatty Acids. Treatment of CD with supplemental fish oil has been demonstrated to reduce the occurrence of relapse. Tsujiikawa and coworkers suggest that the n-3 polyunsaturated fatty acids, taken up in competition with n-6 polyunsaturated fatty acids, decrease the induction of inflammatory eicosanoids such as leukotriene B4 and control inflammation. Others found that supplementation with omega-3 fatty acids delayed relapse. It is not known if the same would occur through a diet rich in omega-3 fatty acids.

Probiotics. Probiotic products contain viable bacteria thought to be helpful in balancing the levels of indigenous microorganisms in the human body. There are some positive but inadequate data to support the use of strain-specific probiotics (Escherichia coli, Saccharomyces boulardii, and Lactobacillus GG), especially Lactobacillus GG, in management of CD. Although generally regarded as safe, some experts question the safety of long-term use of probiotics because they are powerful regulators of host metabolism and have been shown to change the host gene expression. In addition, these preparations may cost from $1 to $3 per day and generally are not reimbursed by third-party payors.

Sports Nutrition Guidelines

Readers are referred to the guidance provided by the Academy of Nutrition and Dietetics and the AAP for specific dietary recommendations before, during, and after physical exercise by youth. Avoiding dehydration and ensuring appropriate nutrition and calorie intake are key issues. Energy, protein, fluid, and vitamin D needs of athletic youth are discussed later in this case presentation.

Energy Needs for Youth and for Youth Athletes

There is great variability in individual needs, especially because of the onset of growth spurt, which is unpredictable. The estimated energy requirement or daily recommended intake for a 10-year-old boy would be 1600 to 2000 kcal. Physical training requires additional calories exceeding those needed for basal energy and growth. Unfortunately, we could not find an estimate of the energy needs for baseball, although there are reports for other sports. For example, a study of 12- to 14-year-old football players estimated the calorie needs to be 2523 ± 936 calories, a wider range than the estimated calorie needs (2400–2800 calories) for an active 12- to 14-year-old male child. Finally, Hart and coworkers studied energy expenditure of children with inactive CD and found that use of the Schofield equation and estimated average requirements for normal children has significant potential to underestimate energy needs. In at least 1 study, the value of measuring rather than calculating the energy needs of youth has been demonstrated.

Fluids and Hydration for Youth Athletes

Avoiding heat illness and fatigue that accompany dehydration is important. Ample hydration is 1 of the recommendations for reducing the risk of exertional heat illness. The AAP policy statement notes that recent studies show that...
youth are not, as previously thought, less effective in regulating body temperature than similarly fit and heat acclimatized adults. Water should be the principal source of hydration unless there is prolonged, vigorous activity or in extreme heat conditions. The AAP provides a list of recommended responses for reducing physiological strain and improving activity tolerance and safety in youth but notes that there are no universal measures.

Types of Fluids. After reviewing the literature, Rowland concluded that given adequate opportunity to drink during exercise, volume driven by thirst of athletes who are older than 9 years but younger than 15 years should be sufficient to prevent significant levels of dehydration (or >1% body weight loss during 2–3 hours of intense exercise). He provides a useful table of recommended minimal fluid intake during and after exercise in child athletes. It is recommended that during training, mandatory fluid breaks be taken every 15 to 30 minutes. During competition, coaches and parents need to monitor fluid intake because the child athlete may be distracted from drinking to thirst. Even drinking to thirst would be expected to leave a small deficit incurred with fluid loss, and therefore, drinking 4 mL/kg to replenish before the next bout of exercise is recommended. He further notes that choice of fluid should be dictated by preference because volume is more important than content. There is evidence that some children experience GI distress after the consumption of carbonated beverages or juice with exercise. The studies comparing intake of sport drinks or water have inconsistent findings. It has been documented that children lose less sodium than adults do through sweat, and therefore, rehydrating beverages or juice with exercise. The studies show that carbohydrate drink is unknown in youth.

In 2011, the AAP Committee on Nutrition and Council on Sports Medicine and Fitness released a clinical report on the appropriateness of sports and energy drinks for children. It defines and compares the effects of sports and energy drinks for children and adolescents. It concludes that given adequate opportunity to drink during exercise, volume driven by thirst of athletes who are older than 9 years but younger than 15 years should be sufficient to prevent significant levels of dehydration (or >1% body weight loss during 2–3 hours of intense exercise). He provides a useful table of recommended minimal fluid intake during and after exercise in child athletes. It is recommended that during training, mandatory fluid breaks be taken every 15 to 30 minutes. During competition, coaches and parents need to monitor fluid intake because the child athlete may be distracted from drinking to thirst. Even drinking to thirst would be expected to leave a small deficit incurred with fluid loss, and therefore, drinking 4 mL/kg to replenish before the next bout of exercise is recommended. He further notes that choice of fluid should be dictated by preference because volume is more important than content. There is evidence that some children experience GI distress after the consumption of carbonated beverages or juice with exercise. The studies comparing intake of sport drinks or water have inconsistent findings. It has been documented that children lose less sodium than adults do through sweat, and therefore, rehydrating beverages or juice with exercise. The studies show that carbohydrate drink is unknown in youth.

Protein Needs of Youth Athletes

It appears that protein needs for child and adolescent athletes mirrors that of adults, 12% to 15% calories for building, repairing, and maintaining other tissue in the body. An active child needs about 0.45 g of protein per pound of body weight each day to maintain healthy body function. Protein bars and shakes vary in the kind and quality of protein used. The most commonly consumed proteins are whey, casein, soy, or rice. Whey and casein come from milk. Whey is fast. Because they are both milk based, they have 1 to 2 g of milk fat and 25 mg of cholesterol per serving. People with dairy allergies or lactose intolerance might limit their intake of these types of products. Soy-based protein supplements are considered to be heart healthy, but those with thyroid disease may be told to avoid these even though they do not appear to be goitrogenic. Soy protein has more antioxidants than casein or whey does that help with free radical scavenging and healing after workouts. Rice-based protein is considered “hypoallergenic” and is recommended for people with sensitive food allergies. Whereas adult athletes involved in strenuous workout consume a high-carbohydrate snack (eg, fruit, fruit juice, oatmeal) an hour in advance, Phelps argues that this may not be appropriate and may be potentially harmful (eg, increased risk of dental erosion, increased risk of obesity) for the youth athletes. Many athletes will tell you that they have heard that after a workout (within 2 hours), they should have a meal with a higher protein-to-carbohydrate ratio to facilitate muscle building. Bars and shakes marketed for postworkout consumption are a mixture of protein, primarily casein and whey, and are designed to be digested at different speeds, allowing the muscles to get a continuous supply of amino acids. The major difference between bars and shakes appears to be that bars have more micronutrients (ie, vitamins and minerals), whereas shakes are protein based with less carbohydrate and fillers. Shakes enhance hydration as well. The protein bars, shakes, powders, and gels appear to be safe when taken as recommended, even for youth athletes. However, for youth who are too heavy for their age, shakes may be contributing excessive calories that lead to fat gain. In addition, some athletes report GI stress after consuming these shakes.

(Editor's note: All of these claims remain unproven)

Vitamin D Needs of Youth

The AAP reports a startling increase in the frequency of severe vitamin D deficiency in both the United States and other countries. In 2008, the AAP issued guidelines that called for a daily intake of 400 IU/d of vitamin D for all infants, children, and adolescents and potentially higher doses for children with chronic diseases who are receiving seizure medications or who have fat malabsorption. There is growing evidence that vitamin D affects physical and athletic performance in adults, but it is not known
Thus, the RD instructed them in the use of MealLogger, a dietary intake easier and more acceptable for athletes.\textsuperscript{27} Saging and food photography have been shown to make inconsistent meal and snack schedules easier. Text messages make recording the food intake of children on happened and also estimated portion sizes. Computer applications can be made. W.K.’s mom acknowledges them to keep record of additional days before specific recommendations can be made. W.K.’s team sport activities are characterized by high-intensity, intermittent efforts that are repeated over the game/practice, which may last up to 4 hours. The RD prescribed a calorie goal of 1800 kcal/d and 23 g of protein. Because the analysis of the diet records displayed a dietary intake very high in calories and protein, the RD asked them to keep record of additional days before specific recommendations can be made. W.K.’s mom acknowledged that they did not record the food and beverage intake as it happened and also estimated portion sizes. Computer applications make recording the food intake of children on inconsistent meal and snack schedules easier. Text messaging and food photography have been shown to make dietary intake easier and more acceptable for athletes.\textsuperscript{27} Thus, the RD instructed them in the use of MealLogger, a photo journaling application that facilitates tracking calorie, carbohydrates, and protein for each meal.\textsuperscript{28} They agree to network their records with the RD.

\textbf{Case Revisited}

Although W.K. and his mom were not looking for an alternative approach to medication control for preventing relapse, the registered dietitian (RD) wanted them to be aware of research on exclusion diets and dietary supplements. W.K.’s mom agrees that it would be good to reduce W.K.’s exposure to medications that may have a long-term toxic effect. However, she does not think the evidence is compelling enough to make a major change in their current lifestyle to accommodate a sugar-free diet. W.K. himself reacted negatively to giving up his pregame candy bar and postgame soda. They do, however, want to maximize the nutrition he can obtain and they are interested in exploring if probiotics or fish oil might be beneficial. The RD provided them education about probiotics and fish oil.

Like all child athletes, the primary nutrition concerns for W.K. include (1) nutrition to maintain normal growth trajectory and prevent obesity, (2) hydration for maximal sports performance, (3) adequate quantity of lean protein, and (4) meeting vitamin and mineral needs. Their calorie needs, even without a chronic condition, may be higher than predicted, and thus, an actual REE measurement is recommended. W.K.’s team sport activities are characterized by high-intensity, intermittent efforts that are repeated over the game/practice, which may last up to 4 hours. The RD prescribed a calorie goal of 1800 kcal/d and 23 g of protein. Because the analysis of the diet records described a dietary intake very high in calories and protein, the RD asked them to keep record of additional days before specific recommendations can be made. W.K.’s mom acknowledged that they did not record the food and beverage intake as it happened and also estimated portion sizes. Computer applications make recording the food intake of children on inconsistent meal and snack schedules easier. Text messaging and food photography have been shown to make dietary intake easier and more acceptable for athletes.\textsuperscript{27} Thus, the RD instructed them in the use of MealLogger, a photo journaling application that facilitates tracking calorie, carbohydrates, and protein for each meal.\textsuperscript{28} They agree to network their records with the RD.

\textbf{Computer applications make recording the food intake of children on inconsistent meal and snack schedules easier.}

The RD impresses on them the need for accurate data to help ensure that W.K. gets sufficient but not too many calories and protein and sufficient vitamins and minerals. The RD notes that with the data she currently has, W.K. does not need a postgame protein shake.

The vitamin D report documented an increase to 49 ng/dL. Because his dietary intake is so low, he is advised to continue with the vitamin D\textsubscript{3} and his levels will be monitored. He is advised to meet his calcium dietary requirement as well. At another visit, concerns about maintaining adequate vitamin and mineral nutriture, especially iron and calcium, an issue not only for a young boy with CD but also for other children engaged in sports, would be addressed. W.K.’s mom agrees that he should have an annual nutrition assessment.

\textbf{Snacking.} For W.K. and all youth athletes, food first with frequent healthy snacks is the recommended dietary route. The need and the benefit for supplemental protein depend on what the youth athlete is eating. It is unlikely that W.K. may benefit from a high-protein snack after the game because based on his diet record, his protein intake is high. There are a wide range of appropriate food snacks that do not require refrigeration and would travel well to the baseball field, such as half a sandwich, cheese and crackers, and cereal bars. On hot and humid days, consuming a salty snack along with water may be advisable. W.K. is willing to consider substituting a low-sugar-protein bar for the pregame candy bar and a protein shake for the postgame soda. The RD reminds them to read the Nutrition Facts label and ingredient list on food products to see how much protein, sugar, and other nutrients are present. She also notes that protein bars and shakes can be expensive if consumed daily and other preworkout and postworkout snacks could be food. A variety of foods can be packed in a lunch box with ice pack, including yogurt and granola, peanut butter or meat sandwich, string cheese and crackers, nuts and dried fruit, low-fat chocolate milk, Greek yogurt, or fruit smoothies, which can be just as effective and may cost less. Some athletes prefer these types of snacks because they are “real food” versus processed foods. For all athletes, foods and beverages need to fit within the child’s daily caloric need to avoid
excessive weight gain. The US Department of Agriculture’s snack guidelines provide guidance for parents. Snacks should be less than 200 calories, with fat being less than 35% of total calories, saturated fat less than 10% of total calories, no trans-fats, and sugar capped at less than 5% of the weight of the food. Examples of snacks can be found at http://foodandhealth.com/usda-school-snack-guide.

**Hydration.** W.K. is told to drink to quench thirst. Although he might be able to incorporate a sport drink into his diet, it probably is not necessary unless he engages in intensive, extended physical activity, such as running for more than an hour. He is encouraged to conduct an experiment and weigh himself before and after practice on a hot and humid day to see how much weight he loses from sweat and then determine how much fluid he needs to replace on those types of game practices and days. W.K.’s mom is willing to share to his coach the recommendation that the players be given 3 to 6 oz of water every 20 minutes during practice and games. If W.K. chooses to use a sport drink, he needs to ensure that it is not replacing important nutrients nor providing unnecessary calories. The RD reminds them that low-fat milk is a good option for postexercise protein requirements. If the players want to use a sport drink, a casein-based drink might be helpful in providing needed calcium. Both W.K. and his mom are reminded that energy drinks are not sports drinks and that the health of children has been harmed by ingesting their stimulant ingredients.

**SMART Goal.** We often conclude a session with the patient setting a SMART goal—specific, measurable, achievable, realistic, and timely. In addition to agreeing to monitor W.K.’s intake, they agreed he might need to increase his caloric intake on practice days. He set his SMART goal to eat a protein bar or shake on practice days.

### Introduction to Case 2

In many communities, family physicians serve as the team physician for high school athletics. Those same communities may lack the services of a sports nutritionist. Nutrition education of student athletes may be provided by coaches, school nurses, health education, or other interested professionals. The family physician may refer student athletes to dietitians in general outpatient clinics for nutrition assessment and counseling. Those dietitians may only infrequently provide services to youth athletes but need to be aware of resources available to assist the patients.

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**The family physician may refer student athletes to dietitians in general outpatient clinics for nutrition assessment and counseling.**

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**Case 2: Unexplained Weight Loss in a 13-Year-Old Female Soccer Player**

G.F. is a 13-year-old previously healthy female athlete who participates in soccer and on a swim team. She is the oldest of 6 children and is excelling in both sports and academics. At her last routine physical, she had a height of 146 cm, weight of 46.8 kg, and BMI of 22.3 kg/m², which plots in the healthy range on the growth chart. She returned to the family medicine clinic 3 months later at the encouragement of her coach because of unexplained weight loss. At that visit, her height was 146 cm, weight was 40 kg, and BMI was 18.8 kg/m² and still plotted in the healthy range. The patient states that she is unsure why the weight loss occurred. She admits she had been on a diet a couple of months ago to lose a few pounds but now she is just trying to “eat healthy.” She reports no purging behaviors. Her thyroid stimulating hormone and free T4 levels were normal. Her albumin level was just above normal at 5.2 g/dL. She has not experienced menarche. Her physical examination was unremarkable and the physician counseled her to “eat a little more carbohydrate” and referred her to the clinic RD for next available appointment for further evaluation. This RD provides medical nutrition therapy and diabetes education for a large family medicine clinic for further evaluation and nutrition education. G.F. and her mother kept their appointment with the RD, which was 6 weeks after her visit with the physician. In preparation for this visit, the RD did a quick literature review and found that female soccer players often have inadequate nutrition for growth and for training and competition.

At this visit, the RD reviewed G.F.’s laboratory values and weight history. The RD plotted the 2 BMI values and found that at G.F.’s routine physical, she had been at the 80th percentile BMI for age at her routine physical and then fell to the 50th percentile BMI for age. When she saw the RD, her weight had stabilized at 40 kg. G.F. again said she was not restricting intake now although she had been pleased with the weight loss when she was dieting. She insists that her food choices are “healthy,” including lots of fruits, vegetables, and lean meats. When the RD attempted to obtain information about portion size and amounts consumed, G.F. was rather vague. G.F.’s mom could not offer a reason for the weight loss, although after reflection, she said there had been some changes in her daughter’s eating. The RD asked if either G.F. or her mother thought she might have an eating disorder (ED), but neither was willing to entertain that discussion.

The RD provided education about the typical nutrient deficiencies experienced by female soccer players. She told G.F. that based on her age, gender, and activity level, she needed an estimated minimum of 2000 calories per day to maintain her weight. However, she noted that many soccer players needed more calories because of high levels of activity. G.F. said that sounded like “too many calories” for her. The RD asked if G.F. was willing to have additional laboratory
work done, to have her REE measure. They set as their SMART goal to keep a detailed food and activity log and bring it to the next visit. Both G.F. and her mother agreed. The RD felt some urgency based on the patient’s affect and responses and scheduled her for follow-up in 1 week. The RD documented in the electronic medical record but also telephoned G.F.’s primary care provider to discuss her impressions and request laboratories. The physician concurred.

G.F. did not return for her follow-up visit in 1 week. The RD was concerned and telephoned G.F. to better understand the missed appointment. G.F. reported that she forgot the appointment and rescheduled for the following week. At this visit, the RD noted that G.F. lost an additional 2.5 kg. Her blood pressure was 111/67 mm Hg, respiration was 20, and temperature was 97.3°F. The laboratory report showed the following: glucose, 54 mg/dL (low); sodium, 142 mEq/L; potassium, 3.8 mEq/L; alkaline phosphatase, 46 units/L (low); serum glutamic pyruvic transaminase, 43 IU/L (high); phosphorus, 3.6 mg/dL; magnesium, 2.3 mg/dL; hematocrit, 38.1%; and hemoglobin, 13 gm/dL. The REE measured using a portable calorimeter (Korr, ReeVue; Korr Medical Technologies Inc) was 947 calories, which was lower than predicted REE of 1234 using the World Health Organization's (WHO) reference value.

The patient scored a 3 out of 5 points, indicating a likely case of anorexia nervosa. The RD shared her concerns and impressions with the patient and her mother. G.F.’s mother then noted she was concerned about some of her daughter’s eating habits since the last visit, as she was seeing some obsessive tendency. She observed G.F. binging and purging foods such as pizza and other G.F. thought were high in fat. G.F. also refused to eat some of the foods she previously enjoyed. The RD administered and scored the SCOFF ED screen (Table 2) at this visit. The patient scored a 3 out of 5 points, indicating a likely case of anorexia nervosa. The RD explained to both the patient and her mother that they were not an expert in caring for elite athletes or those who might have disordered eating. However, the RD told them that G.F. had exhibited some signs that were consistent with an ED. The RD said that her plan would be to confer with G.F.’s primary care physician, recommending that he make an immediate referral with an ED expert. G.F. insisted she was fine, but her mother agreed with the plan. Their SMART goal was to make and keep an appointment with a specialist.

**Background**

**Soccer**

Soccer is a popular sport among young female athletes. It is considered a strength and power contact sport that involves intermittent high-intensity springs between periods of jogging and walking. Many city recreation programs have soccer programs, as do more competitive soccer associations or school teams. Typically, there is a 9-week fall and slightly shorter spring season. In most programs, there is 1 practice and 1 game per week, with practices usually lasting about an hour in later afternoon or early evening and games on Saturday. A tournament may be held at the end of the season and the players would compete in 2 to 3 games during a day. The teams may be all female athletes or may be coed. The competitive programs may travel to other communities.

**Nutritional Concerns of Female Athletes**

**Nutrient Adequacy**

Despite the popularity of soccer, there has been limited research on the dietary habits of youth soccer players. The data do suggest that these players experience nutritional deficits. It appears that female players may not consume adequate carbohydrate for training and competition, folate, vitamin E, calcium, magnesium, iron, and zinc. Similarly, Gibson and coworkers also found that a high proportion of teenage female soccer athletes were not in energy balance (deficit of 462 ± 549 kcal), failed to meet carbohydrate and micronutrient recommendations, and presented with depleted iron and vitamin D status. It has been observed that the energy expenditure during practice or a match could be as much as 1100 kcal. Vitamin D insufficiency (<30 ng/mL) also has been documented in young athletes and dancers. Rosenbloom and coworkers noted that young adult female soccer players have lower energy intakes than needed and also express a desire to lose weight. It is not known if these findings apply to teenage players, although Ruiz and coworkers reported the nutritional intake of younger players actually was better than that of adult players.

**It appears that female players may not consume adequate carbohydrate for training and competition, folate, vitamin E, calcium, magnesium, iron, and zinc.**

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<th>TABLE 2 SCOFF Questions a</th>
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<td>Do you make yourself sick because you feel uncomfortably full?</td>
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<td>Do you worry you have lost control over how much you eat?</td>
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<td>Have you recently lost more than one stone in a 3-month period?</td>
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<td>Do you believe yourself to be fat when others say you are too thin?</td>
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<tr>
<td>Would you say that food dominates your life?</td>
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aOne point for every “yes”; a score of higher than 2 indicates a likely case of anorexia nervosa or bulimia.  
bOne stone is 14 lb.

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Disordered Eating and the Athlete

Most professionals working with female athletes are aware of the concern with disordered eating.33 Disordered eating may cause impaired performance, increased risk of injury, depression, and fluid and electrolyte imbalance. Since the early 1990s, a combination of disordered eating, amenorrhea, and osteoporosis has been recognized as the female athlete triad. It is typically seen less often in sports such as basketball and soccer than in aesthetic sports.41 Sport organizations emphasize the need for early identification and intervention to prevent progression that can permanently harm athletes.33 In 2008, Rosenbloom35 wrote about EDs as 1 of the nutritional challenges for female athletes. Dieting is a risk factor for disordered eating.49 Many patients began their ED after initial purposeful weight loss. Setnick39 reports ED to be classified as process addictions that serve a soothing purpose to stress-related brain chemical imbalances. Youth who are academically or athletically advanced or delayed may feel “different” or “inadequate” and can attribute these feelings to weight or shape differences. As the patient loses weight and discovers that a new desirable size and or shape body does not protect him/her from the negative feelings formerly associated with weight or size, he/she may decide that further weight loss is needed.49 Athletes with disordered eating need health to normalize eating behaviors and redefine their goals related to their performance, school work, and personal life.42 Sundgot-Borgen and Torstveit42 call on coaches, parents, and medical staff to accept that disordered eating can be a problem in the athletic community, and openness regarding the challenge is important. The warning signs, observations, and medical finds in ED are outlined in the Practice Paper of the American Dietetic Association (Table 3).37 It includes observations that family and friends may make, behaviors that may be indicative of a disorder, types of rituals that individuals with EDs exhibit, physiological changes experienced, and medical findings that may be present in an individual experiencing anorexia nervosa, bulimia nervosa, or binge ED. Marked weight changes or absences of expected weight gain in children or adolescents and growth delay in child/adolescents are listed as a general physiological sign. Low blood pressure is listed as a cardiopulmonary sign. Delayed menarche is an endocrine sign.

Screening for ED. Sundgot-Borgen and Torstveit42 recommend that all elite athletes, particularly those competing in leanness sports, receive screening for ED as well as education about health and performance-related nutrition and body composition needs. They reviewed aspects of the disordered eating continuum in elite high-intensity sports; however, little is known about the teenage athlete. There are tools designed to screen for ED, but most are lengthy and may require a specialist’s interpretation.37 Eating Attitude Test is a lengthy questionnaire based on self-report that has been used for some time to help with diagnosis but has a variable performance record.37 The Eating Disorder Examination is a clinician-administered measure that is used by some.37 The SCOFF (Table 2) is a 5-question test that has been recommended as a quick screening tool for professionals, including RDs, in the primary care setting assessing reasons for weight loss.36,43,44 Laboratories. Recommended laboratory tests include serum electrolyte levels, blood urea nitrogen level, creatinine level, thyroid function test, and complete blood count. Additional laboratories for malnourished and severely symptomatic patients may include calcium, magnesium, and phosphorus levels as well as liver function tests.41,43,44 Even with extensive weight loss, 1 characteristic of anorexia is the consistent finding of normal results on blood chemistry tests. Low glucose readings, although rare, can be an indicator of poor outcomes. Abnormal laboratory values in any of the above-recommended laboratories are cause for more immediate attention and may need inpatient admission.

Role of Dietitian and Resources. It should be noted that RDs involved in ED treatment have a responsibility to obtain advanced training, continuing education, and case consultation as well as read the most current research and apply evidence-based treatment recommendations. Registered dieticians who specialize in ED may not be readily accessible to patients in all communities. Therefore, all RDs should know the basic warning signs (Table 3).37 The RD should be able to review and interpret laboratory and anthropometric data and recognize the symptoms of EDs. They should understand the need for immediate treatment and may need to assist primary care physicians in locating appropriate professionals or programs.37,43,44

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Role of RD in Counseling Youth. It would be highly desirable if all athletes had access to the services of a dietitian who holds Board Certification as a Specialist in Sports Dietetics (CSSD) to personalize the nutrition plan for the athlete. When possible, RDs in general practice should help primary care physicians identify RDs who have the additional training and experience to address the nutritional concerns of athletes of all ages.

Case Revisited

It was not clear at the initial visit with the RD if G.F.’s weight loss and poor nutrition were indicative of behaviors associated with female soccer players or of behaviors
TABLE 3  Warning Sign, Observations, and Medical Findings in Eating Disorders

<table>
<thead>
<tr>
<th>Family/friends observations</th>
<th>Reduced spontaneity and flexibility concerning food intake</th>
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<tbody>
<tr>
<td></td>
<td>Avoidance of specific foods</td>
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<td></td>
<td>Poor food variety</td>
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<td>Statements about being or eating “healthy”</td>
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<td>Avoidance of social situations with food</td>
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<td>Abnormal speed at eating a meal</td>
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<td>Attempt to “bargain” about foods (eg, I will eat this if I do not have to eat that)</td>
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<td></td>
<td>Inability to identify hunger or satiety</td>
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<td></td>
<td>Unusually small portions</td>
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<tr>
<td></td>
<td>Inability to define or eat a balanced meal</td>
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<tr>
<td>Behavioral</td>
<td>Active and restless, stands frequently when most people would sit</td>
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<td></td>
<td>Disproportionate time spent thinking about food and body weight</td>
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<tr>
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<td>Interest in recipes, food channels, and food shopping</td>
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<td>Prepares food for other people without eating it themselves</td>
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<td></td>
<td>Subjective or objective binge eating</td>
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<td>Hoards food or rations until the end of the day</td>
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<td>Food seems to go missing, especially sweets, cereals, high-carbohydrate foods</td>
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<td>Appears to be angry, tense, or hostile at meals</td>
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<td></td>
<td>Abnormal timing of meals and snacks</td>
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<td>“Debiting” food intake (eg, with exercise/food choices)</td>
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<tr>
<td>Rituals when eating</td>
<td>Excessive use of condiments (eg, salt, hot sauce)</td>
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<td></td>
<td>Cutting foods into very small pieces before eating</td>
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<td></td>
<td>Inappropriate food utensils, with preference for eating with fingers</td>
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<td></td>
<td>Picks, blots, and tears food apart</td>
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<tr>
<td></td>
<td>Inappropriate food combinations and concoctions</td>
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<td></td>
<td>Eats food in certain order</td>
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<td></td>
<td>Hides food in napkins, handbags, gives to dog, throws food away</td>
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<tr>
<td></td>
<td>Does not let food touch lips</td>
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<tr>
<td>Physiological</td>
<td>General: marked weight changes or absence of expected weight gain in children or adolescents, growth delay in child/adolescent; weakness, fatigue, or lethargy</td>
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<tr>
<td></td>
<td>Cardiopulmonary: low pulse, dizziness, low blood pressure, slow capillary refill</td>
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(continues)
associated with disordered eating. This case serves as a reminder that healthcare providers need to be aware of signs and symptoms of disordered eating in athletes presenting with unexplained weight loss and a stated desire to “eat healthy.” Many medical and behavioral professionals report that they have had little training in the assessment and treatment of patients with EDs and may not detect it until substantial medical and psychological consequences have developed.43,44 G.F. had experienced a 15-lb weight loss over a 3-month period, and although it prompted the primary care physician to refer the patient for medical nutrition therapy, it was without urgency. The patient had convincingly told the physician she was “trying to eat healthy” and had initially tried to lose weight but was not trying to lose weight now. The physician had completed a basic physical with no significant findings. Unfortunately, not all electronic medical records plot BMI for age and gender, so it is important for the provider trying to understand an unexplained weight loss use those tools to evaluate the extent of the percentile change, even if the patient remains in the normal range.

During the first visit with the RD, G.F. was counseled on appropriate nutrition for a teenage athlete,4,32,39 noting that the diet is important for fueling growth and development as well as optimal performance. Although neither an ED expert nor a sports dietitian, the RD knew it was important to determine if G.F.’s eating and dieting behaviors were transient or symptoms of a clinical ED. Even though disordered eating is more often seen in aesthetic sports, it does occur in women participating in soccer and swimming. G.F. expressed doubt that her energy needs might respond to a low glucose level by instructing the patient on treating hypoglycemia with food in this case, the RD is concerned that the low level is an indicator of restrictive eating.45 The RD communicated with the primary care provider that it is recommended that athletes or any patient diagnosed with disordered eating patterns but no other underlying medical disorder who are unable or unwilling to follow the eating recommendations made by the RD or physician be referred to an ED treatment specialist experienced in working with athletes.41 As expected, the primary care physician consulted the RD on appropriate next steps for this patient.

Acknowledgments
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REFERENCES

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**TABLE 3** Warning Sign, Observations, and Medical Findings in Eating Disorders, Continued

| Medical findings | Gastrointestinal: abdominal pain, constipation, reflux, vomiting, delayed gastric emptying (feels full immediately after eating small amounts) |
| Integument: dry skin, brittle nails, hair loss, yellow orange skin tones, white downy hair growth (lanugo), dull eyes, pale skin, cold intolerance |
| Medical findings | Endocrine: loss of menstrual cycle, delayed menarche, or hypogonadism for boys/men |
| Neurpsychiatric: poor concentration, memory loss, insomnia, depression, anxiety, obsessiveness, overconcern with weight and shape |
| Medical findings | Anorexia nervosa: bradycardia, orthostasis by pulse or blood pressure, hypothermia, cardiac murmur, atrophic breasts and vaginitis (postpubertal), pitting edema of extremities, emaciated, cold extremities, slowed capillary refill time |
| Bulimia nervosa: sinus bradycardia, orthostatic by pulse or blood pressure, dry skin, parotid gland swelling, Russell signs, mouth sores, dental enamel erosion, cardiac arrhythmias, may be normal weight |
| Medical findings | Binge eating disorder: Weight-related hypertension, abnormal lipid profile, and diabetes |


