OPTIMAL DIETARY INTAKE

...the basics

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THE PURPOSE OF THIS BOOK

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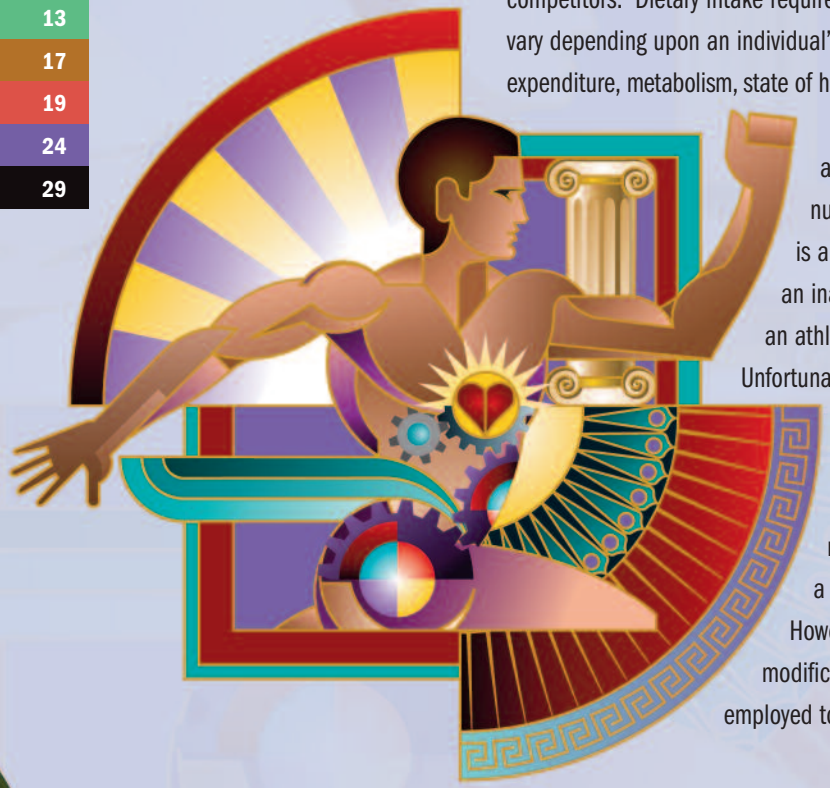


This publication provides general guidelines to help optimize dietary intake for sports competitors. Dietary intake requirements can vary depending upon an individual's energy expenditure, metabolism, state of health, etc.

Now more than ever, athletes need accurate sports nutrition information. Optimal nutrition is an integral part of peak performance while an inadequate diet and lack of fuel can limit an athlete's potential for maximum performance. Unfortunately, there is much misinformation available regarding a proper diet for athletes.

In the quest for success, many athletes will try any dietary regimen or nutritional supplementation promising a new level of physical performance. However, most often an evaluation and modification of current dietary intake can be employed to help maximize peak performance. >>>

The human body must be supplied continuously with energy to perform its many complex functions. As an athlete's training and competition level increases, the body's energy demands also increase. Several energy systems in the body can provide athletes with fuel as long as they are consuming the proper foods. One energy system relies totally on carbohydrates while another uses carbohydrates as well as fats. When an athlete works near or at maximal intensities, carbohydrates are the prime fuel the body can use. During prolonged exercise such as cycling, triathlons, and long-distance swimming, the amounts of fat and carbohydrate used may rise and fall depending upon:

- Duration and intensity of the exercise
- An individual's fitness level
- Food and drink consumed prior to and during the exercise

CARBOHYDRATES – THE MASTER FUEL

A diet rich in carbohydrates increases endurance performance because of the extra store of carbohydrates in the muscles and liver, called glycogen. Work completed in the early 1980's by David Costill at Ball State University showed that if athletes did not consume a diet high in carbohydrates on a daily basis, they would experience chronic fatigue and poor performance. It is well documented that endurance athletes need to replenish carbohydrate stores in the body, especially during periods of intense training. Consuming carbohydrates during workouts lasting over one hour can also benefit performance and delay onset of fatigue. Several recent studies have shown that athletes who participate in stop-and-go sports, such as basketball and soccer, may also need to focus on consuming more carbohydrates. This is not surprising since it is well-known that carbohydrates, when compared to protein and dietary fat, are the most efficiently broken-down and metabolized form of energy for the body. Athletes doing stop-and-go activities were found to have better speeds and to delay fatigue when consuming a higher carbohydrate diet.

Recommended Intake of Carbohydrates

Depending upon the training routine, athletes should consume at least 50 percent, but ideally 60-70 percent of their total calories from carbohydrates. This percentage is only a guideline for estimating carbohydrate needs. Depending upon the length of training sessions, an athlete's carbohydrate intake should be between 2.5-6.0 grams per pound of body weight, with longer training times reflecting the higher number of grams needed. See the table below to calculate grams of carbohydrates needed.

TABLE 1. **DETERMINING GRAMS OF CARBOHYDRATE FOR ATHLETES' NEEDS**

The following example shows how to calculate the recommended grams of carbohydrate needed per pound of body weight.

WEIGHT IN POUNDS		CARBOHYDRATES IN GRAMS		DAILY CARBOHYDRATE INTAKE
160	x	2.5	=	400 grams

Now calculate your own needs. Remember to multiply your body weight by a higher number of carbohydrate grams for lengthier or multiple bouts of training. For example, an hour of training per day may indicate using 2.5 grams in your calculation, and training four or more hours per day may indicate using 6.0 grams.

WEIGHT IN POUNDS		CARBOHYDRATES IN GRAMS		DAILY CARBOHYDRATE INTAKE
	x		=	

Carbohydrate Intake Before, During, and After Exercise

BEFORE EXERCISE:

The pre-exercise or pre-training meal serves two purposes:

- It keeps the athlete from feeling hungry before and during exercise, and
- It maintains optimal levels of energy for the exercising muscles.

Athletes who train early in the morning, before eating or drinking, risk developing low blood glucose levels, as well as a sub-par performance, due to a decreased ability to concentrate and an increased perceived exertion. Blood glucose, the sugar found in the blood, is the energy delivered to the working muscles and organs that allows your body to complete activity. Low blood glucose levels cause you to feel more sluggish than normal and decrease your ability to focus, which inevitably will decrease performance.

Carbohydrate intake before exercise can help to restore sub-optimal glycogen stores, which is critical for prolonged periods of exercise. While allowing for personal preferences and psychological factors, the pre-event meal should be high in carbohydrates, non-greasy, and readily digestible. Fatty foods should be limited as they delay the emptying time of the stomach and take longer to digest. The following are guidelines for the pre-event meal:

- It should be eaten 3-4 hours before an event.
- The meal should provide 150-350 grams of carbohydrates (1.5 grams per pound of body weight).
- To avoid stomach upset, the carbohydrate content of meals should be reduced the closer the meals are to the event.
- Adding small amounts of protein can aid in regulating energy levels by slowing down carbohydrate absorption, delivering the carbohydrates to the working muscles at a more consistent rate over time.
- Pay attention to salty cravings. If competing in hot/humid climates make sure to replace electrolyte losses with salty snack foods, such as pretzels or sport drinks with added sodium.

[*For example, four hours before the event, it is suggested that the athlete consume 1.5 grams of carbohydrates per pound of body weight, whereas one hour before the competition, the athlete would consume 0.5 grams of carbohydrates per pound of body weight.*] *(See Table 2)*

TABLE 2. **SUGGESTED MEALS FOR PRE-EVENT EATING**

1 HOUR OR LESS	SERVING SIZE	GRAMS OF CARBOHYDRATES
Food bar	1 bar	47 g
Raisins	small box (2.5 oz)	34 g
Banana	7 oz	30.6 g
1/2 Bagel	2 oz	26 g
Graham crackers	8 crackers	25 g
Pretzels	20 pieces	22 g
Fig bar (2)	1 oz	20 g
Applesauce	4 oz	14 g
Fluid replacement drink	8 oz	14 g
Toast	1 slice	14 g
Crackers	5 crackers	10 g

(Table continued on page 6)

TABLE 2. **SUGGESTED MEALS FOR PRE-EVENT EATING** (CONTINUED FROM PAGE 5)

2-3 HOURS BEFORE	*SERVING SIZE*	*GRAMS OF CARBOHYDRATES*
Baked potato (plain)	7 oz	58.1 g
Cereal (whole grain)/ low-fat milk (1%)	1 oz cereal 4 oz milk	cereal: 47 g milk: 7.9 g
Bagel (whole grain) with peanut butter	1 bagel (4 oz) 2 tbsp peanut butter	bagel: 47 g peanut butter: 7 g
Fruit smoothie	12 fl oz	46.5 g
Food bar (oatmeal raisin walnut)	1 bar	43 g
Oatmeal (instant)/ low-fat milk (1%)	2 oz oatmeal 4 oz milk	oatmeal: 25.7 g milk: 7.9 g
Yogurt (nonfat)	8 oz	33 g
Pancakes/waffles (from mix)	2.5 oz (5" diameter)	20.1 g
Fresh fruit (chopped apple)	8 oz	19.1 g
Fluid replacement drink	8 oz	14 g

4 OR MORE HOURS BEFORE	*SERVING SIZE*	*GRAMS OF CARBOHYDRATES*
Spaghetti with meat sauce	12 oz	84 g
Pasta/ Chicken/ Vegetables	pasta: 1 cup chicken: 4 oz vegetables: 1 cup	pasta: 60 g chicken: 0 g vegetables: 6 g
Grilled chicken/ rice (white)/ fruit (chopped apple)	chicken: 3.2 oz rice: 5.5 oz fruit: 4.5 oz	chicken: 0 g rice: 44.4 g fruit: 19.1 g
Food bar (oatmeal raisin walnut)/ Fluid replacement drinks	1 bar: 2.4 oz drink: 8 oz	bar: 43 g drink: 14 g
Liquid meal replacement	1 can (11 fl oz)	40 g
Fruit juice	6 oz	18 g
Turkey sandwich (w/3 slices deli meat, 2 slices whole wheat bread low-fat mayo)/baby carrots	turkey: 1 slice mayo: 1 tbsp bread: 1 slice 7 carrots	turkey: 0 g per slice mayo: 1 g bread: 11.8 g per slice carrots: 2.3 g
Tuna sandwich (2 slices whole wheat bread)/ nonfat mayo	tuna: 2 oz drained mayo: 1 tbsp bread: 1 slice	tuna: 0 g mayo: 2.5 g bread: 11.8 g per slice
Trail mix with nuts/raisins	1.1 oz	11 g

EATING AT ALL-DAY EVENTS:

It is important that athletes eat after competing to make sure that they will have enough energy in the muscles for the next race or competition, whether it be in the same day or the following days. The same dietary intake principles used to plan the pre-exercise meal can also apply to foods eaten at all-day events. If an athlete races at 10:00 a.m. and again after two hours, foods that are high in protein and fat will more than likely still be in the stomach potentially causing stomach or gastrointestinal (GI) distress. The following guidelines have been recommended to help athletes make wise food choices at all-day events.

One hour or less between events or heats:

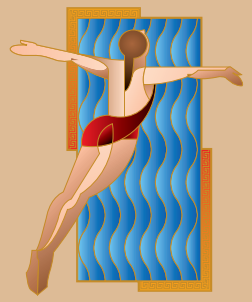
- Stick with carbohydrates that are in liquid form, such as juice.
- If something solid needs to be eaten, try fruits like oranges, watermelon, cantaloupe, peaches, pears or bananas.

These foods consist of mostly carbohydrates and water. They are digested very fast and therefore, will not cause as much of a problem with stomach cramping or GI distress.

Another key point to making food choices with limited time between events is *limiting the quantity of the food eaten.* The more an athlete eats, the longer it will take to digest, especially with any pre-competition nerves or stress.

Two to three hours between events or heats:

- Solid foods in the form of carbohydrates can be eaten, as there is enough time to digest them before competition.
- Try eating bagels, hot or cold cereal with nonfat milk, or english muffins along with fruit like bananas, apples, oranges, peaches, or pears.
- Be sure to drink plenty of fluids, like a fluid replacement drink, for hydration, electrolyte replacement, and restoration of glycogen stores.



FYI

(FOCUS on YOUR INTAKE)

It is best not to try different and new foods before an important competition. If an athlete is complaining of GI distress or stomach cramping, he or she should try different foods or use these guidelines.

Athletes should keep a food log in addition to their training log. They should track what they're eating before, during, and after training and how it affects their performance, both mentally and physically.

Four or more hours between events or heats:

With four or more hours between heats or events, an athlete may want a meal, which should be composed primarily of carbohydrates. Keep the meals simple. The following meal examples for this situation are appropriate:

- A turkey sandwich on two slices of whole wheat bread, low-fat yogurt with fruit, and a fluid replacement drink; or
- Spaghetti with lean meatballs, bread, salad with low-fat dressing, and a fluid replacement drink.

If there is a certain meal pattern before competition that an athlete thinks is a winning combination, then they should stick to it.

Athletes who make food choices at concession stands need to know how to make the best choices. **Most concession stands are filled with high-fat, high-calorie foods that are not designed to maximize performance.** It is always wiser for athletes to pack a cooler from home with winning combinations than to rely on the food at a concession stand. Table 3 has a list of nutrient-dense foods that are easy to pack in a cooler and will help supply energy throughout the day.

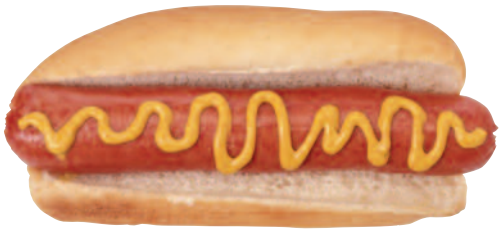


TABLE 3. **COOLER FUELERS**

FOOD	SERVING SIZE	FAT	CARBOHYDRATES	PROTEIN
Baby carrots	7 carrots	0 g	1 g	0 g
Breadsticks	1 stick (2 oz)	6 g	24 g	4 g
Celery	1 large stalk	0 g	2 g	0 g
Cherry tomatoes	5 oz	0 g	7 g	1 g
Chocolate Milk (lowfat)	1 cup	2 g	26 g	8 g
Cottage cheese (lowfat)	4 oz	1 g	3 g	14 g
Dried fruit	1 package	1 g	188 g	7 g
Fluid replacement drinks	8 oz	0 g	14 g	0 g
Food bar (oatmeal raisin walnut)	1 bar	5 g	43 g	10 g
Fresh fruit	8 oz	.5 g	19.1 g	.3 g
Ginger snaps	1 oz	3 g	22 g	2 g
Granola bars	1 bar	3 g	18 g	6 g
Hummus	1/4 cup	5 g	13 g	3 g
Meal replacement drinks	1 can (11 fl oz)	3 g	40 g	10 g
Nuts (mixed)	1 oz	14.6 g	7.2 g	4.9
Peanut butter	2 tbsp	16 g	7 g	8 g
Pita bread (whole wheat large pita)	1 pita	2 g	35 g	6 g
Turkey sandwich (3 slices deli meat, 2 slices whole wheat bread, low-fat mayo)/ baby carrots	turkey: 1 slice mayo: 1 tbsp bread: 1 slice 7 carrots	turkey: .3 g per slice mayo: 5 g bread: 2.3 g per slice carrots: 0 g	turkey: 0 g per slice mayo: 1 g bread: 11.8 g per slice carrots: 2.3 g	turkey: 4.7 g per slice mayo: 0 g bread: 1 g per slice carrots: <1 g
Vanilla wafers	4 wafers	10 g	19 g	<1 g
Whole grain bagel	1 bagel (4 oz)	1.5 g	47 g	11 g
Whole grain cereal	4 oz	1 g	47 g	7 g
Whole grain crackers	5 crackers	15 g	11 g	1 g
Yogurt (nonfat)	8 oz	0 g	15 g	11 g

DURING EXERCISE:

Consuming carbohydrates during exercise lasting longer than 60 minutes ensures that the muscles receive adequate amounts of energy, especially during the later stages of the competition or workout. This has also been found to improve performance. The form of carbohydrates consumed does matter. Some athletes prefer to use a fluid replacement drink, whereas others prefer to eat solid or gel forms of carbohydrates. Use the following guidelines when consuming fluid replacement drinks with carbohydrates:

- Choose drinks that have a carbohydrate concentration between 6-8 percent (g/ml) (see Table 4). These should be consumed in 7-10 fl. oz. amounts every 15-20 minutes. Try drinking in gulps not sips. It is unlikely that a carbohydrate concentration of less than 5 percent is enough to help performance.
- Water is needed to aid in absorption of the carbohydrate. Drinks with a concentration greater than 10 percent are often associated with abdominal cramps, nausea, and diarrhea.
- For high intensity activities, sports drinks and gels containing multiple forms of sugar can increase absorption and delivery of carbohydrates.

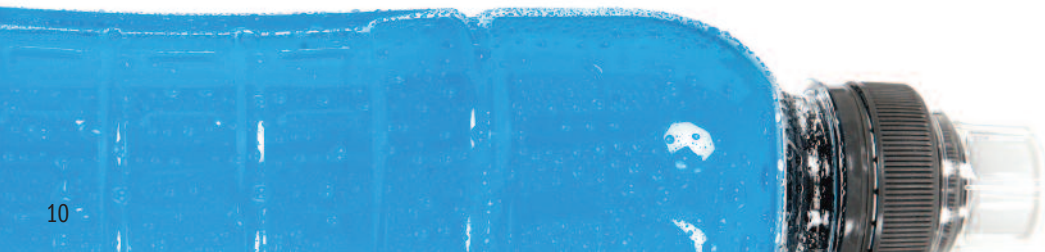
Note: Fluid replacement drinks should not be confused with "energy" drinks. Energy drinks typically contain one or more stimulants.

TABLE 4. **CALCULATING CARBOHYDRATE CONCENTRATIONS IN BEVERAGES**

To assess the concentration of a fluid replacement drink or any beverage, use the following calculations:

$$\frac{\text{AMOUNT OF CARBOHYDRATE IN GRAMS (FROM THE LABEL)}}{\text{THE VOLUME IN ONE SERVING (USE 240 ml PER CUP)}} \times 100 = \text{PERCENTAGE}$$

Example: $\frac{15 \text{ GRAMS}}{240 \text{ ml}} = .625 \times 100 = 6\%$



AFTER EXERCISE:

Delaying carbohydrate intake after exercise will hinder muscle glycogen restoration and impair the ability of the muscles to recover. Consuming carbohydrates immediately after exercise is beneficial. Other points about post-exercise carbohydrate consumption are that:

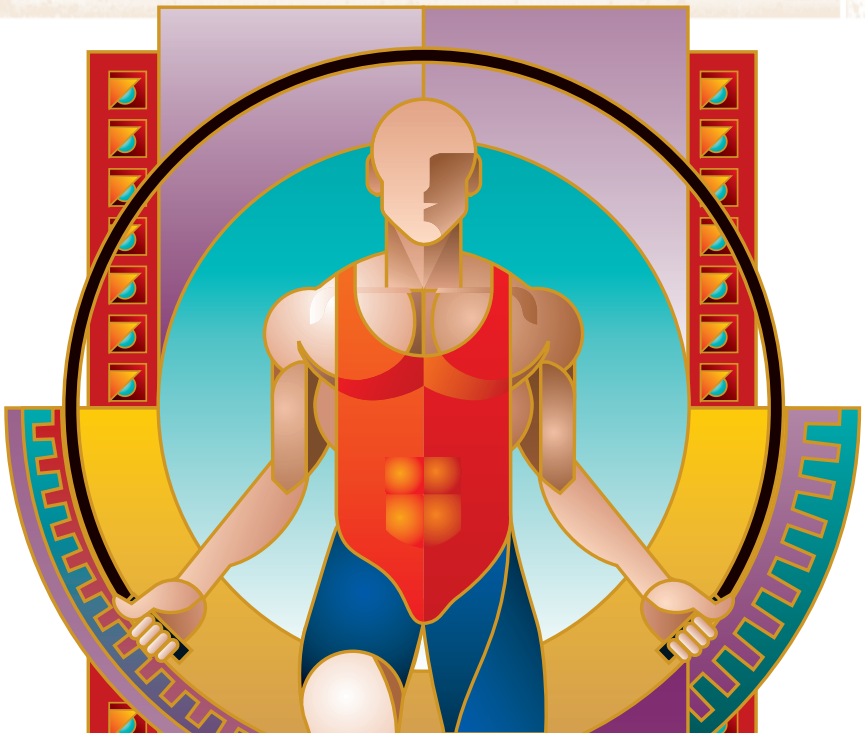
- Exogenous (ingested) carbohydrate intake promotes the muscles to take up more glycogen, thus refueling the athlete faster. This is important to minimize fatigue associated with repeated days of heavy training, tournament play, or in competition in which several races or games are played over one or more days.
- Table 5 gives examples of recovery snacks.
- The recommendation is 0.65 grams of carbohydrates per pound of body weight consumed within 30 minutes after exercise. This should be followed by an additional carbohydrate meal two hours later.
- The first feeding can be a high carbohydrate beverage, followed by eating a high carbohydrate meal. Table 6 gives examples of meals that should be eaten immediately after exercise as well as two and four hours later.

TABLE 5. **RECOVERY SNACK IDEAS**

CEREAL WITH MILK
FRUIT AND NONFAT YOGURT
PITA AND HUMMUS
TRAIL MIX
CHOCOLATE MILK (LOWFAT)
BANANA WITH PEANUT BUTTER

TABLE 6. **RECOVERY MEALS AFTER EXERCISE**

To completely refill energy in the muscle, eat within 30 minutes after exercise and then eat small meals two hours and again at four hours after the workout.
Choose high-carbohydrate foods such as bagels, pasta, fruits, yogurts, cereal with low-fat milk, peanut butter, fluid replacement drinks, food bars, french toast, sub sandwiches, baked potatoes with chili, smoothie made with fruit, fruit juice, yogurt, and frozen yogurt.
Include a small amount of protein to increase insulin levels to further promote carbohydrate absorption as well as aid with muscle recovery and prevent further muscle breakdown.
If you can't consume solid foods within 30 minutes after exercise, try 2-4 cups of a fluid replacement drink and incorporate solid foods two and four hours after exercise.
Be sure to hydrate after a workout or game. Drink 3 cups of fluid for each pound lost during the competition.



PROTEIN'S ROLE AS A TEAM PLAYER

Protein has always been a particularly popular nutrient with athletes because of its role in building and maintaining muscles. Indeed, athletes need to consume a wide variety of high-quality protein foods in their diets. However, while protein is necessary, it is not the primary fuel for working muscles and more protein than the body can use is not going to give athletes larger and stronger muscles. While research shows that protein requirements are higher for athletes to aid in muscle repair and growth, most athletes are already consuming more protein than the body can use. Use the following formulas as guidelines to ensure proper amounts of protein are included in your dietary intake.

TABLE 7. **DAILY PROTEIN RECOMMENDATIONS**

TYPE OF TRAINING	***GRAMS (g) OF PROTEIN RECOMMENDED***
Endurance	0.54-0.64 g of protein per pound of body weight
Strength (to gain muscle mass)	0.72-0.81 g of protein per pound of body weight
Strength (maintenance)	0.54-0.64 g of protein per pound of body weight
Weight Restricted	0.63-0.81 g of protein per pound of body weight

To calculate protein requirements per pound of body weight, use Table 8.

TABLE 8. **PROTEIN REQUIREMENTS IN GRAMS PER POUND OF BODY WEIGHT**

To calculate the amount of protein your body needs on a daily basis, simply take your body weight in pounds and multiple it by the appropriate recommendation. For example, the range of protein for a 185-pound soccer player is 100-118 grams daily.

WEIGHT IN POUNDS		PROTEIN IN GRAMS		DAILY PROTEIN INTAKE
185	x	0.54	=	100 g
185	x	0.64	=	118 g

Calculate your own protein needs. Refer to Table 7 to get the recommended grams of protein for your type of training, and calculate both the low and the high values to get a range of appropriate protein for a daily intake.

WEIGHT IN POUNDS		PROTEIN IN GRAMS		DAILY PROTEIN INTAKE
	x		=	
	x		=	

Table 9 provides additional information to translate this information into servings of protein-rich food.

TABLE 9. **PROTEIN CONTENT OF COMMONLY CONSUMED FOODS**

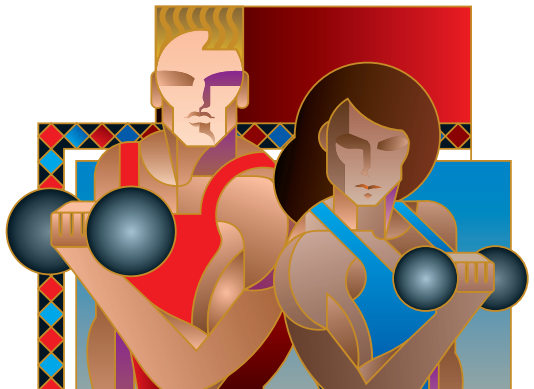
FOOD	SERVING SIZE	GRAMS OF PROTEIN
Chicken breast	3.0 oz	25 g
Ground beef	3.5 oz	24 g
Broiled fish	3 oz	20 g
Cottage cheese	1/2 c	12 g
Yogurt (nonfat)	8 oz	11 g
Cooked lentils	1/2 cup	9 g
Cooked black beans	1/2 cup	8 g
Milk (nonfat)	8 fl oz	8 g
Peanut butter	2 tbsp	7 g
String cheese	1 oz	7 g
Tofu	4 oz	7 g
Egg	1 large or 2 egg whites	6.5 g
Mixed nuts	1 oz	4.9 g
Cooked quinoa	1 cup	4 g
Whole wheat bread	1 slice	2.7 g

Building Body Mass

Many athletes want to add more bulk to their bodies in the form of lean muscle. Many supplement products claim to build muscles. Athletes should take special caution when considering supplementation (please see pages 19-23 for additional information and cautions). Due to the limited regulations of the dietary supplement industry, there is risk of products being contaminated with prohibited substances with or without the manufacturer knowing. Athletes should take special caution when considering supplementation. There is no guarantee that the product contents match with those listed on the label. Taking a lot of extra protein either from supplements or food does not guarantee bigger muscles. If it did, athletes could spend time lounging instead of lifting to build muscles.

A healthier regimen for building muscles would include:

- Following a strength training program that challenges muscles.
- Adding 500 to 1,000 more calories each day to current dietary intake, to allow the body to use protein already present in the diet for muscle growth and not be broken down to fuel activity.
- Eating foods that are both high in carbohydrates and proteins like grilled chicken sandwiches, peanut butter sandwiches, cheese, and crackers.
- Choosing low-fat sources of both carbohydrates and protein.
- Eating several small meals throughout the day to support training and muscle-building.
- Choosing lean animal sources of protein (i.e. dairy and meats) which are more efficiently absorbed by the body.



FYI

(FOCUS on YOUR INTAKE)

Carefully controlled studies have shown that adding proteins, amino acids, or protein powders to a carbohydrate supplement is no more effective for muscle glycogen re-synthesis than ingesting equal calories of carbohydrate alone. However, post-resistance training ingestion of protein in a recovery snack decreases further breakdown and encourages muscle growth.

Protein After Exercise

The body's ability to recover from games, practices, or intense workouts requires adequate rest and proper nutrition. An important component of the recovery process is consuming carbohydrates shortly after exercise, which facilitates the restoration of muscle glycogen (stored carbohydrate energy). Some believe that a mixture of carbohydrates and protein will speed up this process, but that contention is still under debate, with research available to support both theories.

Keep in mind that food is fuel and athletes should not come to practice or games without having had enough food to support the energy requirements for their sport. To keep athletes properly fueled and have protein needs met, use the **EAT guidelines:**

EAT BREAKFAST. It is the best way to start the day well fueled. Include foods that contain carbohydrates and protein such as nonfat milk, yogurt, or an egg.

ADD CARBOHYDRATES AND PROTEIN TO POST-EXERCISE MEALS. Some energy bars provide carbohydrates to replenish the muscle glycogen stores and protein to help build and repair muscles.

TOSS THE SUPPLEMENTS. Athletes should rely on protein from food sources first, instead of supplements. This helps ensure that diets are balanced for health and performance. In addition to meat sources of protein, dairy products, nuts, and seeds are all rich sources of protein and can easily be added to any meal or snack.

DIETARY FAT

Fat Intake In Athletes

Fat is the primary fuel for light to moderate intensity exercise. Although fat is a valuable metabolic fuel for muscles during endurance exercise and performs many important functions in the body, no attempt should be made to consume more fat. With that said, some studies have shown, athletes that consume high-fat diets typically consume fewer calories from carbohydrates.

The more efficient an athlete becomes in their respective sport, the easier it is for them to operate at a lower intensity while maintaining the same level of work or maintaining the same speed (metabolic efficiency). At this lower intensity, stored fat in the muscle can be used as a fuel source. The average 150-pound athlete carries 1,500-2,000 calories in the form of carbohydrates but up to 80,000 calories in the form of fat. The old saying, "Fat burns in a carbohydrate flame" holds true, as fat cannot be used without the presence of carbohydrates. Thus, for efficient endurance and ultra-endurance athletes, carbohydrates are still important, but stored fats help them reach the finish line as well.

A research study looked at muscle biopsies of elite rowers who consumed either 40 percent of their calories from fat or 20 percent of their calories from fat, and also compared the power output and speed of the rowers. The following is a summary of the results:

- The rowers who consumed the low-fat, high-carbohydrate diet had more muscle glycogen.
- The rowers on the high-fat, low-carbohydrate diet had moderate levels of muscle glycogen but were still able to complete the workout sets.
- When it came to power output and faster speeds, those rowers who consumed the low-fat, high-carbohydrate diets had significantly higher power and speed.

This has significant implications for athletes in muscular endurance sports that require a burst of power, such as rowing, swimming, gymnastics, figure skating, judo, boxing, baseball, basketball, or soccer, to have energy generated aerobically.

It is important to recognize that there are many sources of hidden fat in foods. Fat is present, but not separately visible, in:

- Dairy products such as cheese, whole milk, sour cream, and ice cream
- Processed foods such as chips, crackers, granola bars, and french fries
- Cooked meats and fish
- Other food sources like nuts or avocados

Other more obvious sources of fat are in products like margarine, butter, mayonnaise, salad dressing, oils and meats with marbling or visible fat.

Athletes should consume 20 percent to 30 percent of their calories from fat. Aside from decreasing overall calories, limiting consumption of dietary saturated fat is the first step toward losing excess body fat. Doing so eliminates excess calories, but not nutrients. Following a low-fat, high-carbohydrate diet is also important for health reasons, because diets high in saturated fat have been associated with cardiovascular disease, obesity, diabetes, and some types of cancer. Table 10 gives suggestions for reducing fat intake.

TABLE 10. **SUBSTITUTIONS FOR REDUCING FAT INTAKE**

INSTEAD OF:	***TRY:***
Whole milk	Skim milk
Cheddar, jack or swiss cheese	Part-skim mozzarella, string or low-fat cottage cheese, other cheeses that contain less than 5 grams of fat per ounce
Ice cream	Ice milk or low-fat/nonfat frozen yogurt, 100% fruit frozen popsicles
Butter or margarine	Jam, yogurt, ricotta cheese, light or nonfat cream cheese, butter substitute, olive oil, hummus
Sour cream	Nonfat, plain yogurt, light sour cream, blender whipped cottage cheese dressing
Bacon	Canadian or turkey bacon
Ground beef	Extra lean ground beef or ground turkey (at least 95% lean)
Fried chicken	Baked chicken without the skin
Doughnuts and pastries	Bagels, whole-grain breads, homemade breads, low-fat muffins
Apple Pie	Baked or raw apple
Cookies, cakes, brownies	Vanilla wafers, ginger snaps, graham crackers, fig bars

(Table continued on next page)

VITAMINS AND MINERALS

Many athletes may turn to vitamin and mineral supplementation due to confusion over the Recommended Daily Allowance (RDA) and the Dietary Reference Intakes (DRI). The RDAs are recommendations suited for 97-98 percent of the population, based on extensive research. DRIs include RDA recommendations but also include Adequate Intakes (AIs) for nutrients that need more research.

Dietary supplements are defined as products containing "dietary ingredients" intended to supplement the diet. These include vitamins, minerals, amino acids, botanicals, herbs, and substances such as enzymes, organ tissues and glandulars, metabolites, and other dietary supplements.

The question that arises is "do most athletes need to take dietary supplements?" The answer to that question generally is no. Athletes have increased energy needs, which allows them more opportunities to obtain the nutrients they need through a balanced diet composed of a variety of natural foods. Most sports medicine professionals agree that unless an individual has a nutrient deficiency, supplementation may not improve athletic performance. The athlete who takes a simple one-a-day type of vitamin or mineral that does not exceed the nutrient levels of the RDA/DRI is probably not doing any harm. An athlete should consult with his or her physician, or other health care professional, to determine whether vitamin and mineral supplementation is needed to maintain optimal health.

TABLE 11. 1989 RECOMMENDED DIETARY ALLOWANCES (RDA)

	AGE (YR)	(kcal) ENERGY	(g) PROTEIN	(mg RE) VITAMIN A	(mg α-TE) VITAMIN E	(µg) VITAMIN K	(mg) VITAMIN C	(mg) THIAMIN	(mg) RIBOFLAVIN	(mg NE) NIACIN	(mg) VITAMIN B_6	(µg) FOLATE	(µg) VITAMIN B_{12}	(mg) IRON	(mg) ZINC	(µg) IODINE	(µg) SELENIUM
Males	15-18	3000	59	1000	10	65	60	1.5	1.8	20	2.0	200	2.0	12	15	150	5
	19-24	2900	58	1000	10	70	60	1.5	1.7	19	2.0	200	2.0	10	15	150	70
	25-50	2900	63	1000	10	80	60	1.5	1.7	19	2.0	200	2.0	10	15	150	70
Females	15-18	2200	44	800	8	55	60	1.1	1.3	15	1.5	180	2.0	15	12	150	50
	19-24	2200	46	800	8	60	60	1.1	1.3	15	1.6	180	2.0	15	12	150	55
	25-50	2200	50	800	8	65	60	1.1	1.3	15	1.6	180	2.0	15	12	150	55

1997 DIETARY REFERENCE INTAKES (DRI)

	AGE (YR)	(µg) VITAMIN D	(mg) CALCIUM	(mg) PHOSPHORUS	(mg) MAGNESIUM	(mg) FLUORIDE
Males	14-18	5	1300	1250	410	3.2
	19-30	5	1000	700	400	3.8
	31-50	5	1000	700	420	3.8
Females	14-18	5	1300	1250	360	2.9
	19-30	5	1000	700	310	3.1
	31-50	5	1000	700	320	3.1

Source: RDA was adapted and reprinted with permission from *Recommended Dietary Allowances*, 10th edition © 1989 by the National Academy of Sciences. Courtesy of the National Academy Press. Washington, D.C.: Committee on Dietary Reference Intakes,, *Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride* (Washington, D.C.: National Academy Press, 1997).

EXAMPLES OF FOODS RELATED TO RDA AND DRI

PROTEIN
Asparagus
Beef
Beans (black/pinto/lima/kidney)
Chicken breast
Salmon (baked or broiled)
Tuna (baked or broiled)
Turkey breast

VITAMIN A
Bell peppers (raw)
Cantaloupe
Eggs
Liver
Raw carrots
Spinach
Sweet potatoes

VITAMIN E
Eggs
Fruit
Leafy green vegetables (spinach)
Meats
Nuts
Poultry

VITAMIN K
Asparagus
Cauliflower
Dairy products
Leafy green vegetables (spinach)
Peas
Wheat

VITAMIN C
Apples
Asparagus
Broccoli
Citrus fruits
Melons
Potatoes
Spinach
Tomatoes

THIAMIN
Beef
Legumes (beans, lentils)
Milk
Nuts
Oats
Pork
Whole grain cereals

RIBOFLAVIN
Dairy products (milk, eggs)
Green vegetables (spinach, broccoli)
Liver
Meats

NIACIN
Green vegetables (asparagus, broccoli)
Cereal grains
Meats
Liver
Fish
Dairy products (milk, eggs)

VITAMIN B_6
Carrots
Cereal grains
Dairy products (milk, cheese)
Fish
Legumes (beans, lentils)
Liver
Peas
Potatoes
Spinach

FOLATE
Asparagus
Beans (pinto/black/garbanzo/kidney)
Broccoli
Liver
Melons
Okra
Spinach

VITAMIN B_{12}
Dairy products
Fish
Hard boiled eggs
Liver
Meats
Milk
Shellfish

IRON
Fish
Grain products
Leafy green vegetables
Legumes (beans, lentils)
Meat
Nuts
Poultry
Strawberries

ZINC
Beans
Fish
Lean red meats
Liver
Oysters
Peas

IODINE
Milk
Seaweed
Tuna

SELENIUM
Butter
Fish
Garlic
Nuts
Raisins
Shellfish
Sunflower seeds
Wheat

VITAMIN D
Cod liver oil
Eggs
Exposure to the sun
Fish
Fortified milk

CALCIUM
Dairy products (milk, cheese)
Salmon
Shrimp
Tofu
Yogurt

PHOSPHORUS
Dairy products (milk, cheese)
Dried beans
Fish
Meats
Nuts
Peanut butter

MAGNESIUM
Beans
Leafy green vegetables
Nuts
Peas

FLUORIDE
Drinking water
Fish (including bones - sardines)
Tea

ATHLETES SHOULD NOTE THAT: *THE USE OF NUTRITIONAL OR DIETARY SUPPLEMENTS IS COMPLETELY AT THE ATHLETE'S OWN RISK. EVEN IF THE SUPPLEMENTS ARE "APPROVED" OR "VERIFIED."*

Athletes taking nutritional or dietary supplements may test positive for a prohibited substance which is not disclosed on the product label. Sanctions are imposed in accordance with applicable rules for all positive test results.

Some trade associations and other businesses have programs that include analytical testing and quality assessment of dietary supplements, culminating in a "stamp of approval' or a "guarantee" that the supplement is safe for use in sport. These programs may reduce the risk that a supplement is contaminated, or contains an undisclosed ingredient. ***HOWEVER, it does not eliminate this risk.*** Bottom line: USADA warns athletes against taking any dietary or nutritional supplement. Athletes who take dietary or nutritional supplements, even if "approved" or "verified," do so at their own risk of committing an anti-doping rule violation.

An athlete who replaces food with supplements can put his or her health at risk. A handful of supplements for breakfast, followed by several tablespoons of assorted products containing trace minerals or powdered protein supplements and herbs throughout the day, will not provide the health benefits and needs found in food.

Natural foods contain a matrix of various nutrients that researchers are continuing to discover and learn more about. Often individual nutrients don't work as effectively when isolated in a pill or supplement form.

Self-prescribed supplement users should heed overdose warnings, and look for symptoms of toxic levels of supplementation, such as diarrhea, skin rashes that do not fade, and unexplained joint pain. Fat soluble vitamins (A, D, E, and K) can be toxic when misused. Unlike water soluble vitamins in which excess amounts are excreted in the urine, fat soluble vitamins are metabolized in body fat and remain in the body.

Remember that more is not always better. The established recommended RDA and DRI for vitamins and minerals are to be used as a guide in determining nutritional needs. These allowances have a large margin of safety built into the recommendations. Even though it has been shown that a severely inadequate intake of certain vitamins and/or minerals can impair performance, it is unusual for an athlete to have such severe nutritional deficiencies. Even marginal deficiencies do not appear to markedly affect the ability to exercise efficiently.

Athletes searching for a competitive edge often look to a supplement or a special combination of nutrients to find it. However, there are no quick-fix supplements for improving sports performance. Consuming a wide variety of foods and staying well hydrated are the basic cornerstones to reaching athletic potential.

Supplements and Your Health

Background. The increased visibility of many vitamins, minerals, herbals, as well as other dietary supplements, some argue, can be attributed to the passage of the Dietary Supplement Health and Education Act (DSHEA) in 1994. Under DSHEA, the Food and Drug Administration (FDA) DOES NOT approve any supplements including vitamins, minerals, amino acids, herbals, and other botanical preparations for safety or efficacy (whether they work).

Additionally, the passing of DSHEA allowed manufacturers to publish only limited information about the benefits of dietary supplements. It is easy for products to get to the marketplace without pre-market controls, and if necessary, they are extremely difficult to remove, even when serious health concerns are raised about their safety.

The Anabolic Steroid Control Act of 2004 (SB 2195) took effect on January 20, 2005 as an amendment to the Controlled Substances Act. The Act classifies a number of pro-hormones or steroid precursors, previously manufactured as dietary supplements, as controlled substances, making their distribution illegal without a medical prescription. According to this Act, possession and/or distribution of these substances can be punishable by up to five years in prison.

Did you know? While some mainstream supplements are made by responsible manufacturers, a growing number of supplement products contain dangerous and undisclosed ingredients, including steroids, stimulants and other dangerous drugs. One major issue is that unscrupulous companies are marketing supplements spiked with these dangerous substances, taking advantage of many consumers' desires for maximized sport performance or aesthetic improvements, and advertising them as healthy and safe products when they're not.

Most Americans are unaware that designer steroids and other dangerous drugs are intentionally being sold as dietary supplements and that current law makes it too easy for these products to get to the market. Best estimates suggest that there are hundreds of supplement products currently available that contain one or more of approximately 20 to 25 designer steroids alone. For example, in a 2004 study funded by the International Olympic Committee, 18.8 percent of the 245 supplements analyzed from the United States were found positive for steroids. In a 2007 HFL study, of the 54 supplements that were analyzed for stimulants, 6 were positive (11.1 percent); of the 52 supplements analyzed for steroids, 13 were positive (25 percent).

Contamination does occur. While not every high profile athlete who claims a contaminated supplement is to blame for a positive doping test is necessarily telling the truth, given the overall probability of supplement contamination, the risk of taking a mislabeled supplement is a real threat to the careers of American athletes and the health of all consumers. In the United States, high-profile athletes who test positive from contaminated supplements containing undisclosed prohibited substances can be made ineligible for competition.

Beyond undisclosed substances that are prohibited in sport, studies have also shown that nutritional supplements contain unsafe and undisclosed levels of lead and other substances that are a general public health concern.

The health consequences are numerous. The consumption of these dangerous hidden drugs, such as designer steroids, has been a known cause of liver injury, stroke, kidney failure and pulmonary embolism.

The inclusion of stimulants in supplement products also has the potential for harmful effects. Some stimulants can cause increased blood pressure, irregular heart rhythm, stroke, or even death.

Protect yourself! This is a REAL concern. Rather than relying on advertisements from companies who are trying to sell you their product, as a consumer, you have the responsibility to educate yourself. In the world of anti-doping, strict liability applies and athletes are responsible for what is in their systems at the time of a drug test. Anabolic steroids and stimulants are prohibited classes of substances in sport. It is up to the athlete or consumer to research reliable sources of information that can point out the many substances that are known to be included in supplements and that may, in fact, damage one's health or an athletic career.

More Information. For more information on supplement concerns in the United States and to learn about a USADA initiative that brings together many sport entities to improve the supplement regulatory landscape, please visit ***www.supplementsafetynow.com.*** You can also find more information about dietary supplement warnings and the current WADA List of Prohibited Substances and Methods at ***www.USADA.org/substances.***

Please note: USADA's Drug Reference Line™ and Global Drug Reference Online™ do not provide information about dietary supplements.

FLUIDS AND HYDRATION

Fluid replacement is one of the most important nutritional concerns for an athlete. Approximately 60 percent of body weight is water. As an athlete trains or competes, fluid is lost through the skin through sweat and through the lungs while breathing. If this fluid is not replaced at regular intervals during practice or competition, it can lead to dehydration. A dehydrated athlete has a decreased volume of blood circulating through the body, and consequently:

- The amount of blood pumped with each heart beat decreases
- Exercising muscles do not receive enough oxygen
- Exhaustion sets in and the athlete's performance suffers
- By-products of exercise are not flushed out of the body as regularly as they should be

Research has repeatedly shown that dehydration, affecting as little as 2 percent of total body weight, can adversely affect athletic performance. For example, if a 150-pound athlete loses 3 pounds during a workout or competition, their ability to perform at peak performance due to dehydration is reduced. Proper fluid replenishment is the key to preventing dehydration and reducing the risk of heat-injury in athletes engaged in training and competition.

Preventing Dehydration

The best way to prevent dehydration is to maintain body fluid levels ("euhydration") by consuming plenty of fluids before, during, and after a workout or competition. Often, athletes do not realize that they are losing body fluids or that they are impacting their performance through dehydration. Athletes who are not sure how much fluid to drink can monitor hydration using two helpful techniques:

- Weighing before and after practice. For every pound lost during the workout, drink three cups of fluid in order to rehydrate the body.
- Checking urine color. Urine that is dark gold in color indicates dehydration. Urine similar in color to pale lemonade or weak tea is a sign of a hydrated athlete.

Many times athletes wait to drink until they are thirsty. Thirst is not an accurate indicator of how much fluid an athlete has lost. Athletes who wait to replenish body fluids until feeling thirsty are already dehydrated. As a matter of fact, most individuals do not become thirsty until more than 2 percent of body weight is lost. Waiting until you are thirsty can affect your performance. When athletes only drink enough to quench their thirst, they may still be dehydrated. For best results, keep a bottle of fluid available when working out and drink as often as desired, ideally every 15-20 minutes. Table 12 lists guidelines for fluid replacement from the National Athletic Trainers Association, the American Dietetic Association, and the American College of Sports Medicine.

TABLE 12. **GUIDELINES FOR PROPER HYDRATION**

- ***MONITOR FLUID LOSSES:*** Weigh-in before and after training, especially during hot weather and conditioning phase of the season
- ***FOR EACH POUND*** lost during exercise, drink three cups of fluid
- ***DO NOT RESTRICT*** fluids before, during, or after the event
- ***DO NOT RELY*** on thirst as an indicator

What About Fluid Replacement Drinks?

It is now believed that fluid replacement drinks containing between 6 and 8 percent glucose or sucrose are absorbed into the body more rapidly than water and can provide energy to the working muscle that water cannot. A growing body of evidence suggests that consumption of a fluid replacement drink containing carbohydrates can delay fatigue and possibly improve performance. It appears that athletes who consume a fluid replacement drink can maintain blood glucose levels at a time when muscle glycogen stores are diminished. This allows carbohydrate utilization and energy production to continue at high rates. Beverages containing more than one kind of sugar (i.e. glucose and fructose) can increase carbohydrate absorption rates because each sugar is absorbed via different channels.

How Important are the Electrolytes Provided by Fluid Replacement Drinks?

The ingestion of sodium during exercise may help with maintenance or restoration of plasma volume during exercise and recovery. The consumption of fluid replacement drinks containing sodium helps retain water in the body and aids in hydration by increasing the absorption of fluid from the intestines into the muscles. Recent research has suggested that a 6-8 percent carbohydrate sport drink with at least 110 mg of sodium per 8 oz. serving empties from the stomach just as fast as plain water. Endurance activities lasting longer than 3 hours may require as much as 175 mg of sodium per 8 oz. serving.

There has been concern by parents, coaches, and athletes that sports drinks may contain too much sodium. However, many fluid replacement drinks are low in sodium. An 8 oz. serving of a fluid replacement drink can have a sodium content similar to that of a cup of reduced fat milk. Most Americans consume too much sodium through processed and convenience foods, not through fluid replacement drinks.

The Ideal Fluid Replacement

The ideal fluid replacement beverage is one that tastes good, does not cause GI discomfort or distress when consumed in large volumes, promotes rapid fluid absorption and maintenance of body fluid, and provides energy to working muscles during intense training and competition.

FYI	(FOCUS on YOUR INTAKE)

Fluid Monitoring. Average sweat rates from numerous research studies range from 0.3-2.4 L/hr. Average sweat concentrations of sodium range from .5-1 g/L. With this level of variation, it is important for an athlete to monitor their own fluid and electrolyte losses and work with their coaches or sports registered dieticians to determine their sodium and fluid needs.

Guidelines for Fluid Replacement

The following guidelines for maintaining body fluid balance, improving performance in the heat, and preventing heat-related illness appear to be prudent based on current scientific knowledge.

- For intense training and long workouts, a fluid replacement drink containing carbohydrates may provide an important source of energy. A 6-8 percent carbohydrate beverage is typically most effective in maintaining fluid balance while supplying the muscles with fuel.
- The fluid consumed during activity should contain a small amount of sodium and electrolytes. The sodium may be beneficial for quicker absorption and replacement of sweat loss.
- The beverage should be palatable and taste good.
- The athlete should drink 10-16 ounces of cold fluid about 15-30 minutes before workouts. If the workout is prolonged, add carbohydrates to the beverage at a 6-8 percent concentration.
- Drink 4-8 ounces of cold fluid during exercise at 15-20 minute intervals.
- Start drinking early in the workout because thirst does not develop until 2 percent of body weight has been lost, by which time performance may have begun to decline.
- **Avoid carbonated drinks,** which can cause GI distress and may decrease the volume of fluid consumed.
- **Avoid beverages containing caffeine, alcohol, and those promoted as "energy drinks."**
- If you have never used a fluid replacement drink, don't use it for the first time during a game or on race day. Practice consuming fluids while you train. Use a trial and error approach until you discover the fluids that work well for you and that encourage hydration.

BOTTOM LINE

Nutrition plays a critical role in athletic performance, and athletes, coaches, and parents need to realize that making wise food choices can increase the chances of optimal athletic performance. It is easy for athletes to fall prey to nutrition misinformation and fad diets in the search for a quick fix to improve performance. It is imperative that athletes stay current on accurate nutrition issues as they are ever-changing. By making informed food choices, athletes will have an advantage over those who choose to ignore the role that food plays in human performance.

Resources:

www.acsm.org	American College of Sports Medicine
www.eatright.org	American Dietetic Association
www.cfsan.fda.gov	Center for Food Safety and Applied Nutrition - U.S. Food and Drug Administration
www.usda.gov/cnpp	Center for Nutrition Policy and Promotion
www.healthierus.gov/dietaryguidelines	Dietary Guidelines for Americans, 2005
www.nutrition.gov	National Agricultural Library, U.S. Department of Agriculture
www.drugfreesport.com/choices	National Center for Drug-Free Sport
www.healthfinder.gov	National Health Information Center - U.S. Department of Health and Human Services
www.win.niddk.nih.gov	National Institutes of Health
www.nata.org	National Athletic Trainers' Association
www.scandpg.org	Sports, Cardiovascular, and Wellness Nutrition, a dietetic practice group of the American Dietetic Association

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Note: The content of this publication is provided for informational purposes only and is subject to change. This information is not intended to be a substitute for professional medical advice, diagnosis, or treatment. Individuals should always seek advice from a qualified health professional.

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