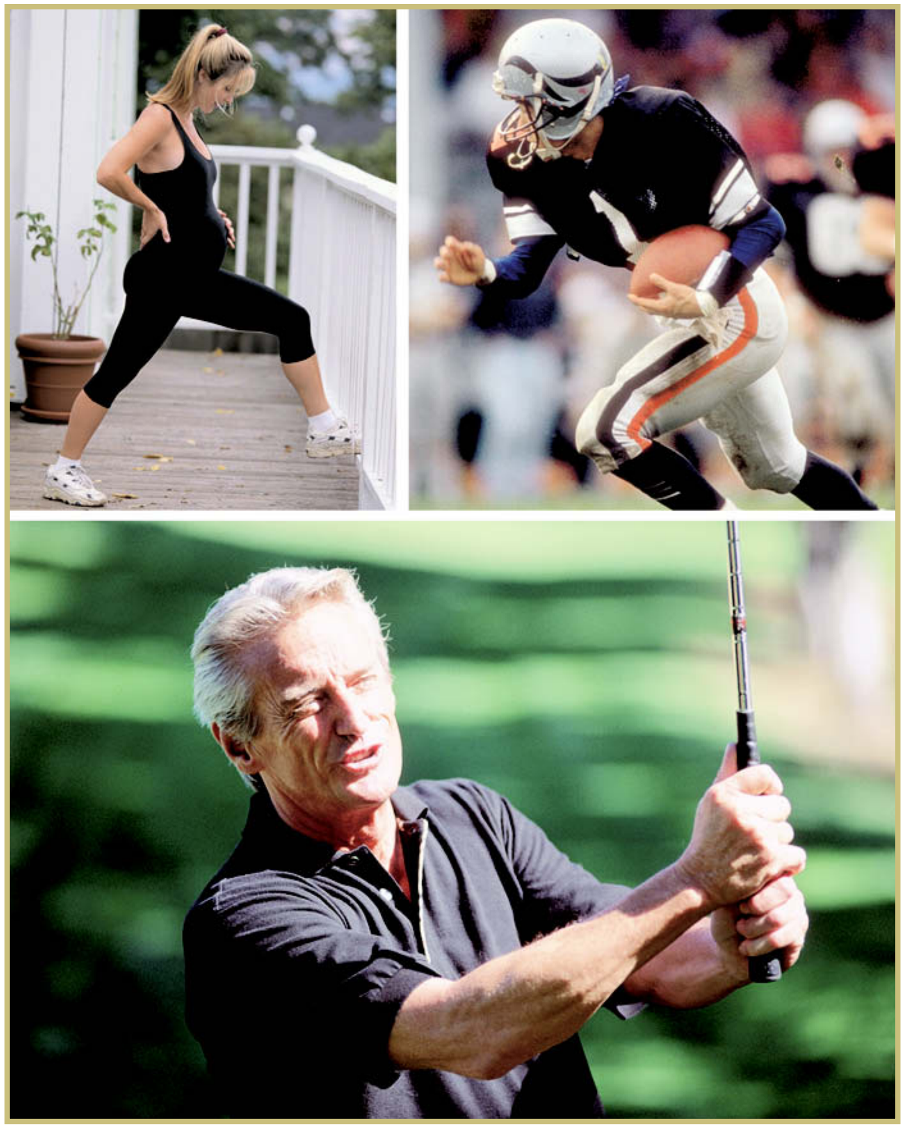
Introduction to Sports Nutrition

INTRODUCTION TO SPORTS NUTRITION

A nutritious diet is one that meets all of the body's macro- and micronutrient demands on a daily basis. That being said, there doesn't exist one perfect diet for everyone. Certainly, many diet books would have you believe that everyone can follow a particular nutrient prescription to attain optimal nutrition and body weight, but if that were the case, there would only be one diet book and only one diet. It's unreasonable to assume that a pregnant 32-year-old female, a 75-year-old man with hypertension, and a 22-year-old college football star all have the same nutrient requirements (Figure 1). Nutrient intakes are based on individual factors, including a person's size and activity level, the types of activities performed, and genetic predisposition. Additionally, an individual's diet should reflect adequate food variety for nutrient balance, be palatable while meeting the daily demands of stress placed on the body, and contribute to an acceptable quality of life.

Nutrition for sport performance goes one step further. When the body is placed under excessive strain as a result of training at competitive levels, the demand for nutrients surpasses that of normal homeostasis. The term *homeostasis* refers to the natural state of balance within the body with all systems functioning properly. Heavy performance demands disrupt the natural homeostatic condition, because the body is bombarded with significant stressors. As a result, an athlete's body needs more electrolytes and water to preserve

FIGURE 1—The optimal nutrient intake depends on the individual.



cellular hydration, more antioxidants to protect cell membranes, more energy to fuel exercise and training, and higher nutrient concentrations to enhance recovery. If the average competitive athlete consumed a 2,000-calorie diet, it wouldn't be long before his or her performance declined due to inadequate nutrient consumption. To optimize performance, an athlete's diet must be developed specifically for his or her relative needs.

Sports versus Health and Fitness

Sports are as diverse as the individuals who play them. Some are high-powered, such as football, tennis, and hockey, requiring large amounts of work, rapid movements, and significant force management; whereas others are more endurance-based, such as cross-country running and triathlon training, which require sustained lower force outputs for longer durations.

The nutrition needs of each player or participant are specific to the demands of the sport. The *principle of specificity* used for programming exercise and sport conditioning drills suggests that the physiological adaptations to the activity are specific to the demand. Similarly, the nutrient needs of an athlete are specific to the physiological demands of his or her sport. Muscles that produce high tension need more protein for recovery, whereas muscles that perform high volumes of work need more carbohydrates to replenish glycogen (sugar) stores. Additionally, active bodies that produce large amounts of heat need more water and electrolytes to replace those lost during the practice or competitive event. Identifying the actual demands of a sport, along with the added challenges of practice and training, is the first step in developing a nutrition plan for athletic performance.

It's important to understand the differences in required nutrition for health, fitness, and athletic performance. *Eating for health* suggests a conservative approach to nutrition and focuses on keeping all body systems functioning properly. A person striving to eat healthfully should focus on consuming adequate amounts of nutrients, with the basic goal being to consume foods that meet the needs of normal function. Additionally, the foods selected should serve to prevent nutrient deficiencies or excesses that may increase the risk of developing health-related problems or diseases. When combined with moderate physical activity, a healthy diet should prevent weight gain, help to maintain appropriate body composition, and prevent any adverse health issues.

Specifically, a healthy diet for the average individual is calorie controlled and composed primarily of a variety of fruits and vegetables, complex carbohydrates, and lean protein (Figure 2). At the same time, it also limits the consumption of unhealthy fats, processed carbohydrates, and simple sugars. These guidelines form the basis of the *recommended daily allowances (DRI-RDAs),* as provided by the United States Department of Agriculture. The RDAs are designed to address the nutrient needs for more than 90% of the population.

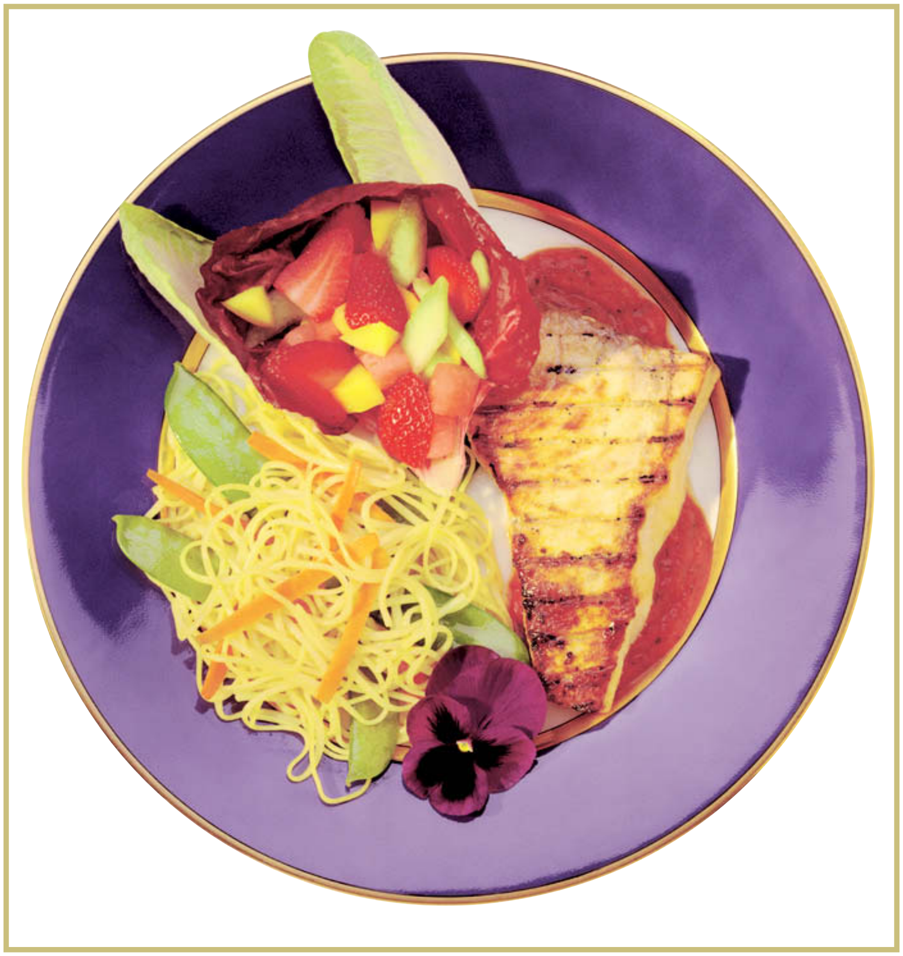


FIGURE 2—A variety of fruits, vegetables, and lean proteins comprise the building blocks of a healthy diet.

Dietary adjustments can be made for individuals who have nutrient deficiencies, who are susceptible to certain diseases, or who have developed chronic health problems such as *hypertension* (high blood pressure) or *hyperlipidemia* (high levels of blood lipids). When a particular health issue arises, the diet should be manipulated to alleviate the factors that aggravate the condition. For instance, an individual with high blood pressure would lower his or her consumption of salt while increasing potassium, whereas an individual with high cholesterol would need to reduce the amount of saturated fat and cholesterol in his or her diet. In essence, healthy eating should concentrate on keeping all systems within the healthy ranges for a particular person.

Eating for fitness differs from eating for health because greater focus is placed on supporting moderate to vigorous activity while maintaining lower levels of body fat. Fitness nutrition emphasizes food intakes that optimize health-related fitness measures. A diet of this nature is designed to support training for cardiorespiratory and muscular fitness while improving body composition. Individuals who regularly exercise above the adaptation threshold need more calories than those who are classified as simply being active. Routine participation in resistance training and aerobic exercise requires additional levels of both energy- and non-energy-yielding nutrients beyond that needed for basic health. Again, an individual's specific caloric needs depend on the person's size, body composition, and total volume of training. Individuals who participate in fitness training will often burn 1,000 to 2,000 calories a week. Competitive athletes, however, may burn more than 1,000 calories in one day (Figure 3).

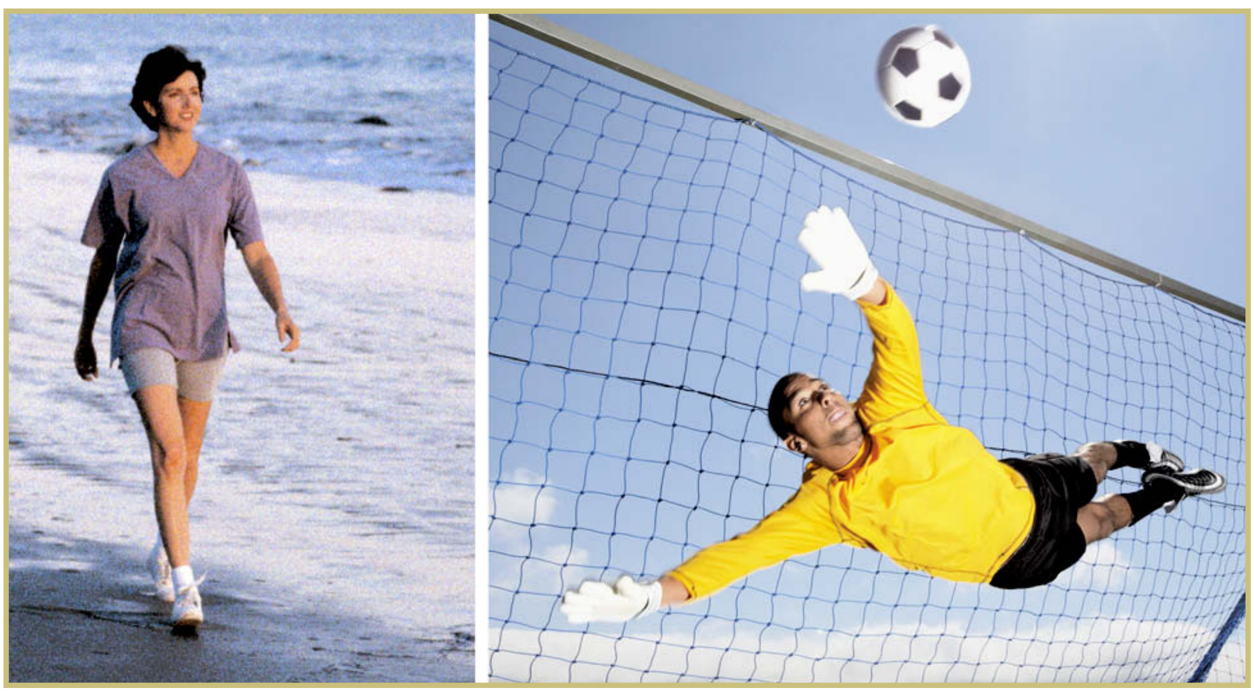


FIGURE 3—Depending on an individual's activity level, a person can burn anywhere from 1,000 calories a week to 1,000 in one day.

Because the energy demands of athletic performance are much higher, *sports* or *performance nutrition* is often much more focused on total calories consumed, where those calories come from, and, more specifically, the timing of consumption. Athletes must have adequate energy for strength and conditioning activities, practice sessions, as well as competitive events. In an interview during the 2008 Summer Olympics, Michael Phelps stated that he attempted to consume approximately 15,000 calories a day to support his five-hour workouts. Although this may be extreme, it illustrates the point that all athletes must pay attention to fueling all of their activities. A college athlete, for instance, may train and practice a combined three to four hours for his or her sport most days of the week. Human physiology dictates that if energy isn't constantly replenished for work, the performance of the tissue will be compromised. Likewise, if adequate nutrients aren't in place for recovery, subsequent training bouts can be negatively affected.

Sports nutrition requires emphasis in three areas:

1. Pre-training nutrition
2. Nutrition during the event
3. Post-event nutrition

Today, thanks to modern science, sports nutrition has a vastly expanded our knowledge in these three areas. Our current knowledge of sports nutrition comes from both a historical and clinical perspective. For example, Hippocrates, the ancient Greek physician, correctly related appropriate nutrition and exercise to improved human function. According to Hippocrates, writing around 450 BC:

> All parts of the body which have a function, if used in moderation and exercised in labours in which each is accustomed, become thereby healthy, well-developed, and age more slowly, but if unused and left idle they become quickly liable to disease, defective in growth, and age more quickly.

Many centuries later, the work of our scientific forefathers has advanced to a significant understanding of how modern nutrition affects human performance. Observational data and clinical research have unlocked the door to enhancing performance through dietary enrichment. Many of the dietary habits of ancient athletes have morphed into a structured diet of metabolically specific nutrients and optimal intake values. This partly explains why human achievement in athletic events has experienced significant advances over the last several decades.

The Demands of Sport

Recall that sports nutrition is based on the demands of the sport and the athlete's training regimen. These demands affect the metabolic activity that manages the stress of sports-specific training. Energy is needed to produce force, to transfer and break down nutrients, to buffer nutrient byproducts, and to regulate temperature. The magnitude of the demand is based on the intensity of the movement (i.e., speed or force), the duration of the action, and the efficiency of the tissues. For example, a 230-pound middle linebacker in American football must move a considerable amount of body weight at high speeds during a football game; a tennis player must dash left to right and generate significant force to return the ball while maintaining dynamic equilibrium for positional control; and a boxer must endure round after round of hard punching under constant movement. Each athlete will have varying contributions from *anaerobic* (energy produced without oxygen) and *aerobic* (energy produced using oxygen) energy sources. The more sugars they burn and the more fluid they lose, the faster they'll fatigue. This explains why athletes consume Gatorade and similar energy drinks during events.

The rate at which an athlete fatigues is based on several factors, including the storage of energy in the cells before activity, the athlete's hydration status, and the level of intensity employed during the activity. Not allowing for proper rest and recovery following a bout of activity can also adversely affect an individual's fatigue rate. High-intensity anaerobic activities such as sprinting, jumping, and weightlifting drain the muscles' sugar stores very rapidly because the intensity of the activity is too high for other nutrient contributions, such as energy from fat. When athletes don't consume enough carbohydrates between bouts of training or practice, they quickly drain an already low fuel tank. Think of an athlete as an automobile. Without enough gasoline, the car is limited in the distance it can travel (Figure 4).

FIGURE 4—An athlete's fuel needs are similar to those of a car. Without enough energy, an athlete will become fatigued much more quickly than if training with a full tank of carbohydrates.

Energy, however, isn't the only limiting factor. When an athlete isn't properly hydrated, extracellular fluid stores are depleted and the body's electrolyte balance (referred to as *fluid osmolarity*) is altered. This causes further detriment in cell function and a fairly linear decline in performance. To prevent this problem, athletes must consume adequate energy in the form of carbohydrates and manage fluid intake before, during, and after activity.

In addition to the energy used for mechanical work (locomotion), chemical reactions can also affect performance. The use of carbohydrates can occur at higher rates than fats and proteins, because they can be used for energy without oxygen. But instead of forming a by-product of water (H_20), carbohydrate breakdown in the absence of oxygen produces hydrogen ions (H^+), which alters the cellular environment and leads to fatigue. The high rate of carbohydrate use not only reduces energy storage levels within the cells, but it also increases the number of hydrogen ions in the cell, and these ions must be cleared for enzymes to function properly. To prevent the accumulation of hydrogen ions, the body must employ chemical and ventilatory buffers to remove the hydrogen, further increasing energy use.

At the same time, electrical-to-chemical transmissions from the spinal cord to the muscle strain the nervous system, which is already under high force demands. Sodium-potassium pumps that initiate action signals are challenged by repeated wear and electrolyte loss, and heat created from the thousands of enzymatic reactions must be dissipated to prevent the body from overheating.

Clearly, an athlete's body is under significant stress, and to manage these stresses the body must produce more energy. For this reason, athletes must constantly consume food, but what they eat and drink is as important as the amount of calories being consumed.

Throughout this study unit, you'll be asked to check your understanding of what you've just read by completing a "Self-Check." Answering these questions will help you review what you've learned so far. If you've missed any answers, or you feel unsure of the material, review this material until you feel that you understand the information presented. Please complete *Self-Check 1* now.

Self-Check 1

At the end of each section of *Introduction to Sports Nutrition,* you'll be asked to pause and check your understanding of what you've just read by completing a "Self-Check" exercise. Answering these questions will help you review what you've studied so far. Please complete *Self-Check 1* now.

1. What is *homeostasis?*

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2. List four factors that affect a person's optimal nutrient intake.

   ____

3. List the components of a health-based diet.

   ____

4. An individual who exercises above the adaptation threshold most days of the week burns approximately how many calories in one week?

   ____

5. Why is it so important for athletes to pay such close attention to their diets?

   ____

6. What are the three components of sports nutrition?

   ____

7. Why is a constant supply of energy so important? List four reasons energy is needed.

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8. List several factors that can result in an athlete's early fatigue.

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Check your answers with those on page 35.