



Fueling for Performance:

How proper timing of meals affects both sport and academic performance

Nutrition is critical for both academic and sports performance. A diet that is adequate in carbohydrate, protein, healthy fat, vitamins, minerals, and fluid is the foundation of day-to-day eating for overall health. As important as *what* to eat, though, is *when* a student athlete eats. The right fuel at the right time influences how well they feel, learn, perform, and recover.

In order for student athletes to meet their daily energy needs, they need to fuel early and often. Studies show that students who eat breakfast before school have better concentration, attention span, and memory, three benefits that are significant for both sports and scholastic performance. (1) Consuming food and fluid at regular intervals throughout the day has also been shown to impact total health, body composition, and overall feelings of satiety (appetite satisfaction) and well-being.

The bottom line: When and how often the student athlete eats impacts how nutrients will be used, health, body composition, athletic performance, and recovery.

Timing Foods and Fluids before Exercise

Fueling before exercise has been shown to improve performance over exercising in the fasted state. (2) Carbohydrate-rich foods and fluids help to increase or “top off” muscle glycogen stores, prevent hunger, and provide a mental boost for the athlete. It is recommended that athletes consume approximately 1 g/kg carbohydrate 1 hour before exercise, 2 g/kg 2 hours before, and so on. (3) As the time before exercise increases, the amount of carbohydrate will increase. Larger amounts of carbohydrate (3 to 4 g/kg) are appropriate when more time is available (3 to 4 hours prior). The time required for foods to digest depends on the type and quantity of the food consumed. Eating a smaller amount of food and choosing foods lower in fat and fiber will help to reduce risk of gastrointestinal (GI) distress.

In addition to foods, timing the pre-exercise fluid is critical to prevent dehydration and allow adequate time for excretion of any excess fluid. At least 4 hours before exercise, individuals should aim to drink 5 to 7 mL/kg water or a sports drink (or 2-3 mL/lb). (2)

Timing Foods and Fluids during Exercise

Athletes who perform endurance or intermittent high-intensity exercise for more than an hour are at risk for glycogen depletion, hypoglycemia, and fatigue during exercise. Consuming 30 to 60 grams of carbohydrate each hour during prolonged exercise will prevent the under-fueling trap. (2) This recommendation is based on the maximum rate of glucose absorption from the GI tract, which is estimated to be 1 g/minute or 60 g/hour. (2) Carbohydrate consumption should begin shortly after the

start of exercise. Sports drinks that contain 6 to 8% carbohydrate are a popular and convenient choice among athletes during exercise as a quick source of fluid, carbohydrate, and electrolytes. Consumption of 6 to 12 ounces (180 to 360 mL) of sports drink with a 6 to 8% CHO every 15 to 30 minutes during exercise has been shown to extend exercise capacity of athletes that participate in intermittent exercise such as basketball, tennis, soccer and volleyball (4). However, each athlete should refine these strategies according to his or her own sweat rate. (see Eating During Exercise fact sheet for more ideas).

Timing Foods and Fluids after Exercise

The goal of recovery nutrition is to replace fluid, electrolytes, and glycogen that were lost during activity, make new muscle protein, red blood cells, and other cellular components, and provide adequate carbohydrate, amino acids, and minerals to promote proper immune function. (3) Both carbohydrate and insulin are needed to optimize glycogen stores—consuming carbohydrate-rich foods or fluids provides glucose, which stimulates the release of insulin from the pancreas.

The 45 minutes after exercise is considered the “window of opportunity” for recovery nutrition due to multiple factors, such as increased blood flow and insulin sensitivity, facilitating an increase in glucose uptake and glycogen restoration. To maximize the rate at which muscle glycogen is replaced, athletes should consume a carbohydrate-rich snack within this window. Athletes should aim to consume 1 to 1.2 g/kg/hour for the first 4 hours after glycogen depleting exercise (2).

When glycogen restoration must happen quickly (such as for athletes who perform multiple, prolonged training bouts in the same day), a medium to high glycemic index meal is the best post-exercise choice. Examples include foods with quickly digested and absorbed carbohydrate and little fiber or fat (see Eating Frequency fact sheet for more ideas). For most athletes, muscle glycogen can be adequately restored through lower glycemic index carbohydrates that do not promote a significant spike in insulin. (4)

After exercise it is important to provide the body with the nutrition it needs to resynthesize tissues that were catabolized during exercise. The stimulation of muscle growth may be further enhanced by the inclusion of 15 to 25 grams protein with carbohydrate and fluid in the post-exercise meal. (2)

Timing of Day-to-Day Nutrition

While the amount and timing of carbohydrate before, during, and after exercise plays an important role in sports performance, it must not be considered more important than the day-to-day diet. Total dietary intake over the course of days, weeks, and months must be adequate or else training and performance will be negatively affected. First and foremost, the body must meet its daily energy needs. Insufficient overall calories will limit storage of carbohydrate as muscle or liver glycogen. All athletes should make it a priority to eat regularly throughout the day.

A sports dietitian can help an athlete understand these guidelines by translating the science of meal timing into practical examples of what, when, and how much food and fluid to consume at any given time. Refer to the *Eating Frequency* fact sheet for a practical application of meal timing.

Author

Written by SCAN Registered Dietitians (RDs). For advice on customizing a nutrition plan, consult a RD who specializes in sports, particularly a Board Certified Specialist in Sports Dietetics (CSSD). Find a SCAN RD at www.scandpg.org.

References

- 1.) Gajre NS, et al. Breakfast eating habit and its influences on attention-concentration, immediate memory and school achievement. *Indian Pediatrics*. 2008; 45:824-8.
- 2.) Sports, Cardiovascular, and Wellness Nutrition Dietetic Practice Group, Rosenbloom C, Coleman E. Sports Nutrition: A Practice Manual for Professionals, 5th edition. Academy of Nutrition and Dietetics: 2012.
- 3.) Dunford M, Doyle A. Nutrition for Sport and Exercise, 2nd edition. Wadsworth Publishing: 2008.
- 4.) Sawka MN, Burke LM, Eichner ER, Maughan RJ, Montain SJ, Stachenfeld NS. American College of Sports Medicine Position Stand. Exertional heat illness during training and competition. *Med Sci Sports Exerc*. 2007;39-556-72.