

Nutrition

Fact Sheet

Fueling the School-Aged Athlete – Carbohydrates Rule for Fuel

Carbohydrates Provide Energy

Carbohydrate is the primary fuel for the athlete. In general, as the intensity of exercise increases, more carbohydrate and less fat is used to supply energy. However, compared to adults, school-aged athletes use less carbohydrate and more fat for energy in moderate exercise and are less efficient at using carbohydrate for high intensity activity (Montfort-Steiger & Williams, 2007). Despite these differences, carbohydrates supplied by whole grains, fruits, and vegetables should be the major source of energy in the diets of most children and adolescents. This is especially true for active children and young athletes.

Carbohydrates Promote Health

As well as providing a source of energy for muscle, carbohydrate foods

- provide glucose for the brain,
- spare protein as a source of energy,
- are an excellent source of vitamins and minerals, and
- have additional benefits for athletes.

In trained adult runners, high carbohydrate intake has been associated with improved performance and mood (Achten et al., 2004). Carbohydrates may also improve immune function during strenuous exercise (Gleeson, 2006; Nieman, 1998).



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Carbohydrate Confusion

Low-carbohydrate diets have become popular and have created confusion about dietary carbohydrates. Some athletes may think carbohydrates are fattening and stop eating breads, potatoes, and pasta. This can cause low body carbohydrate stores, low energy, and low performance. Carbohydrates, in and of themselves, are not fattening, but eating more than your body needs puts on the extra pounds. Research has shown that some young athletes are eating even less, carbohydrates than what is recommended for non-active children. This may prevent them from replenishing their carbohydrate stores (Ruiz et al., 2005).



Building Carbohydrate Stores

The body stores carbohydrate as muscle and liver glycogen. Having a reserve of glycogen is important for high-intensity athletic endurance events that depend on glucose for energy. Athletes say they have “hit the wall” and are too mentally and physically tired to continue when glycogen stores get very low. Adult endurance athletes have improved endurance and performance when muscle glycogen stores are increased (Jacob & Sherman, 1999). Information on glycogen storage and performance for school-aged athletes is lacking. However in a study of adolescent soccer players, the amount of glycogen used and time to exhaustion were associated (Rico-Sanz, Zehnder, Buchli, Dambach, & Boutellier, 1999). For these soccer players, enhanced glycogen stores improved performance.

Studies on adult athletes have shown glycogen storage increases as carbohydrate intake increases (Burke et al., 1995). Also, consuming carbohydrates after exercise is important for replenishing glycogen stores (Burke, Kiens, & Ivy, 2004). This appears to be similar for adolescent soccer players. Zehnder, Rico-Sanz, Kühne, and Boutellier, (2001) found an intake of 4.8 grams of carbohydrate per kilogram of body mass almost restored muscle glycogen to pre-game levels. Additional carbohydrate intake was suggested to prevent daily glycogen deficits.

Since the body’s limited amount of stored carbohydrate determines how long exercise can last, some adult endurance athletes may try to dramatically increase muscle glycogen before competitive events. They use a technique called carbohydrate loading or glycogen supercompensation. A variety of carbohydrate loading procedures have evolved based on manipulating dietary carbohydrate and altering training (McArdle, Katch, & Katch, 2008).

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Carbohydrate loading is not recommended for school-aged athletes because of

- **No Benefit** – School-aged athletes do not typically compete in ultra endurance events, such as marathons, that exhaust muscle glycogen stores.
- **Safety Risks** – Carbohydrate loading has not been studied in school-aged athletes. Depending on the procedure, health hazards may include vitamin and mineral deficiencies, irritability, and loss of lean tissue (Meyer, O'Connor, & Shirreffs, 2007).

Carbohydrates to Snack on Before, During, and After Athletic Events












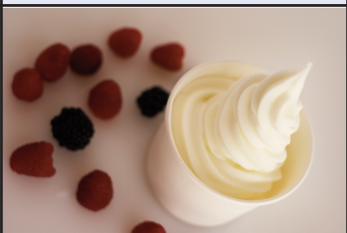
Although recommendations about carbohydrates have been developed for adult athletes, much is unknown about fuel needs of school-aged athletes. In general, a high carbohydrate diet is recommended for most athletes including teenagers (Meyer et al., 2007; Montfort-Steiger & Williams, 2007). The optimal amount of dietary carbohydrates will depend on the specific sport or activity, individual needs, and personal preferences. All healthy children can benefit from a diet that contains about 45–65% of energy from carbohydrate (ADA, 2008).

Eating a carbohydrate-rich snack, 2–4 hours before competition, will top-off the tank. Depending upon the athlete and activity, carbohydrate stores can be replenished by eating carbohydrate-rich snacks 0–4 hours after competition (Burke et al., 2004).



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Nutrient-Rich Carbohydrates

GRAINS	Breads: Whole wheat bread Multi-grain bread Bagel English muffin Whole wheat tortillas Corn tortillas Whole wheat pita	Rice: Brown Wild White Noodles Pasta: Whole wheat Ravioli	Muffins: Fruit Bran Pancakes Crackers and Cookies: Whole-grain Animal Fig cookie
			
STARCHY VEGETABLES	Beans: Lima Pinto Black-eyed peas Kidney	Lentils Potatoes Sweet Potatoes Corn Plantains	Yams Squash: Acorn Butternut
			
FRUITS	Fresh: Berries Bananas Melons	Canned: Look for juice packed Pineapple Peaches	Dried: Raisins Apricots Cranberries
			
MILK	Milk: Skim Chocolate, lowfat	Lowfat Yogurt: Plain Fruit	Frozen Yogurt
			

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For More Information

American Dietetic Association. www.eatright.org

BAM! Body and Mind. www.bam.gov

CDC Fruits and Veggies – More Matter (Centers for Disease Control and Prevention, HHS, NCI). www.fruitsandveggiesmatter.gov

MyPyramid for Kids. www.mypyramid.gov

PBH Fruits and Veggies – More Matter. www.fruitsandveggiesmorematters.org

Portion Distortion. hp2010.nhlbihin.net

President's Council on Physical Fitness and Sports. www.fitness.gov

Recipes from a Healthier You. (Based on the Dietary Guidelines for Americans, 2005). www.health.gov

SCAN–Sports, Cardiovascular, and Wellness Nutritionists – A Practice Group of the American Dietetic Association. www.scandpg.org

References

- Achten, J., Halson, S. L., Moseley, L., Rayson, M. P., Casey A., & Jeukendrup, A. E. (2004). Higher dietary carbohydrate content during intensified running training results in better maintenance of performance and mood state. *Journal of Applied Physiology*, *96*, 1331-1340.
- American Dietetic Association. (2008). Position of the American Dietetic Association: Nutrition guidance for healthy children ages 2 to 11 years. *Journal of the American Dietetic Association*, *96*, 1038-1047.
- Burke, L. M., Collier, G. R., Beasley, S. K., Davis, P. G., Fricker, P. A., Heeley, P., et al. (1995). Effect of coingestion of fat and protein with carbohydrate feedings on muscle glycogen storage. *Journal of Applied Physiology*, *78*, 2187-2192.
- Burke, L. M., Kiens, B., & Ivy, J. L. (2004). Carbohydrates and fat for training and recovery. *Journal of Sports Sciences*, *22*, 15-30.
- Gleeson, M. (2006). Can nutrition limit exercise-induced immunodepression? *Nutrition Reviews* *64*, 119-131.
- Jacob, K. A., & Sherman, W. M. (1999). The efficacy of carbohydrate supplementation and chronic high-carbohydrate diets for improving endurance performance. *International Journal of Sports Nutrition*, *9*, 92-115.
- McArdle, W. D., Katch, F. I., & Katch, V. L. (2008). *Sports & exercise nutrition* (3rd ed.). Philadelphia, PA: Lippincott, Williams, & Wilkins.
- Meyer, F., O'Connor, H., & Shirreffs, S. M. (2007). Nutrition for the young athlete. *Journal of Sports Sciences*, *25*, 73-82.
- Montfort-Steiger, V., & Williams, C. A. (2007). Carbohydrate intake considerations for young athletes. *Journal of Sports Science and Medicine*, *6*, 343-352.

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- Nieman, D. C. (1998). Influence of carbohydrates on the immune response to intensive, prolonged exercise. *Exercise Immunology Review*, 4, 64-76.
- Rico-Sanz, J., Zehnder, M., Buchli, R., Dambach, M., & Boutellier, U. (1999). Muscle glycogen degradation during simulation of a fatiguing soccer match in elite soccer players examined noninvasively by ¹³C-MRS. *Medicine & Science in Sports & Exercise*, 13, 1587-1593.
- Ruiz, F., Irazusta, A., Gil, S., Irazusta, J., Casis, L., & Gil, J. (2005). Nutritional intake in soccer players of different ages. *Journal of Sports Sciences*, 23, 235-242.
- Zehnder, M., Rico-Sanz, J., Kühne, G., & Boutellier, U. (2001). Resynthesis of muscle glycogen after soccer specific performance examined by ¹³Cmagnetic resonance spectroscopy in elite players. *European Journal of Applied Physiology*, 84, 443-447.

For more information, contact NFSMI at 800-321-3054 or www.nfsmi.org.

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