THE POWER OF NUTRITIONAL RECOVERY

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In a previous issue of CQ, we discussed the concept of how a swimmer's recovery from one workout can affect the quality of his or her next practice. In this article we will review this concept and revisit the basic strategy to optimize nutritional recovery between workouts.

We know, that the total amount of energy required to perform an activity increases with exercise intensity. We also know that carbohydrate and fat tend to be the body's fuels of choice during a variety of exercise intensities (the body will tap into protein as a fuel source only when carbohydrate and fat are not readily available). (See Figure 1.) Because less oxygen is required to access a molecule of carbohydrate compared to a molecule of fat (i.e. carbohydrate "costs" less), carbohydrate is metabolically easier to access than fat. For this reason, carbohydrate becomes the primary contributor to the total amount of energy required as training sets toughen. For us, this means that swimmers (sprinters, in particular) rely heavily on carbohydrate as their primary fuel source during most workouts. Much of this carbohydrate comes from the storage form, glycogen.

There is a direct link between fatigue and muscle glycogen depletion. Over time, if the glycogen spent during one workout is not replenished prior to the next, the net effect is a reduction in the amount of glycogen available to fuel the tough sets. Should the intensity of the work remain too high for the body to rely on fat as the primary fuel source (which it will!), the body will turn to protein. Generally this translates into tissue breakdown or damage. Although some tissue damage is normal with training, this series of events demonstrates the importance of replenishing glycogen stores after every workout, not only to maintain energy reserves from workout to workout, but also to limit the amount of tissue damage per workout and over time (see Figure 2.).

Figure 1. Fuel Sources During Swimming.

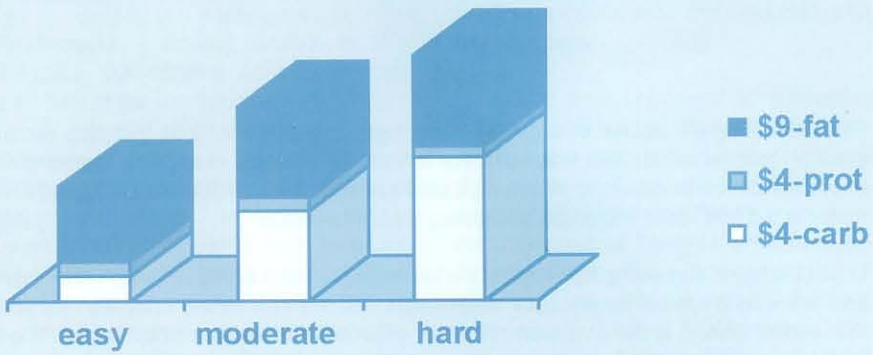
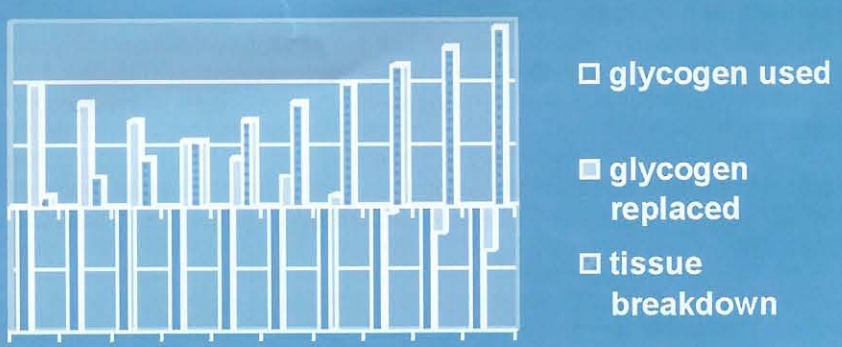


Figure 2. Long-term failure to replace glycogen leads to tissue breakdown.



Depending on the extent of depletion, it can take as long as 24 hours to fully replenish glycogen stores and repair muscle tissue, but the first two hours post-workout are the most critical. Given the right fuel, glycogen synthesis during this time can occur as much as *two to three times faster* than normal. This is due to the increased sensitivity of muscle cells to the hormone insulin, which rises in response to an increase in blood sugar (i.e. after eating carbohydrate). It is insulin's job to remove sugar from the blood and store it, preferably as glycogen. At most times during the day, there is a limit to the amount of glycogen that can be stored at one time, and once that limit has been reached, the remaining blood sugar may be stored as fat. This is a good reason to eat smaller amounts of carbohydrate at more frequent

"After exercise, the dietary goal is to provide adequate energy and carbohydrates to replace muscle glycogen and to ensure rapid recovery. If an athlete is glycogen-depleted after exercise, a carbohydrate intake of 1.5 g/kg body weight during the first 30 min and again every 2h for 4 to 6h will be adequate to replace glycogen stores. Protein consumed after exercise will provide amino acids for the building and repair of muscle tissue. Therefore, athletes should consume a mixed meal providing carbohydrates, protein, and fat soon after a strenuous competition or training session." (ACSM, ADA, Dietitians of Canada Joint Position Statement on Nutrition and Athletic Performance, 2000, p 2131)

Maximize Nutritional Recovery

intervals during the course of a day, or to eat high-carbohydrate foods that also contain some protein, fat and/or fiber (each of these lessens the glycemic response). Thanks to the body's enhanced sensitivity to insulin right after exercise, the exception to this storage limitation is the two hours immediately following a tough workout.

Experts suggest that eating carbohydrate in the amount of 1.2-1.5 g/kg/hr for up to five hours post-workout is optimal for glycogen re-synthesis. There is also strong evidence indicating that adding protein to the post-workout snack enhances the insulin response, resulting in more glycogen storage. Some experts suggest that adding protein simply creates a more anabolic (muscle-building) state during recovery. Regardless, while carbohydrate is the body's top preferred nutrient for the post-workout snack, including protein (one gram for every four grams of carbohydrate) is likely to enhance recovery by enhancing glycogen storage or preventing post-workout tissue breakdown or both. It's a win-win situation.

So believe in the power of recovery. Encourage your athletes to bring their post-workout snack to the pool every day. Those who have a significant drive home should be eating it in the car and then having a decent meal when they get home. Those who live close to the pool should have it ready right after practice to eat on the way home or as soon as they walk in the door. Solid foods are great, but oftentimes liquid nutrition (for example: Instant Breakfast® homemade smoothies) is more tolerable after heavy exercise. Individual preference will play a role, but the end result will be positive for your athletes and your program. Go USA!

For more information on Nutrition for Swimmers, visit the nutrition section of the USA Swimming website at http://www.usa-swimming.org/programs/template.pl?opt=coaches&pubid=2682.

- Start the replenishment process IMMEDIATELY! The "window of opportunity" for maximizing glycogen repletion starts to close as soon as exercise stops...it lasts for about two hours.
- Pulse the system. Try to eat something substantial every hour versus waiting for the large meal or eating only every three to four hours.
- Something is better than nothing. If a swimmer just can't meet the 1.2-1.5 g/kg/hr for at least two hours recommendation, consuming some carbohydrate fuel immediately after workout will do more to help prevent chronic or long-term glycogen depletion than consuming nothing at all.

Body Weight	Carbohydrate Required to meet Intake of 1.2 g/kg	Amount of Common Commercially-Available 6% Carbohydrate Bottled Sports Drink	Food Examples (per hour)
120-150 lbs	65-85 grams	35-50 oz/hr	2 cups apple juice or cranberry cocktail OR 2 servings of low-fat yogurt OR 1 cup dried apricots OR 2 cans Carnation Instant Breakfast®
160-200 lbs	85-110 grams	50-65 oz/hr	2/3 cup raisins OR 4 cups grapefruit juice or orange juice OR 2 medium bagels OR 4 slices watermelon OR 1 bagel with peanut butter
+200 lbs	115+ grams	65+ oz/hr	8 kiwi fruits OR 2 cups canned fruit salad OR 3 cans SlimFast®