CYCLING PERFORMANCE TIPS

BEVERAGES/FLUIDS

by Richard Rafoth, M.D.

Although water does not provide calories, adequate fluid intake and hydration is at least as important as calorie replacement in maximizing your athletic performance. The single biggest mistake of many athletes is their failure to replace their fluid losses during training and competitive events. And this is especially true in cycling where evaporative losses are significant and can go unnoticed even though sweat production and loss through the lungs can easily exceed 2 quarts per hour. To maximize your performance, it is essential that fluid replacement begin early and continue throughout a ride. A South African study comparing two groups of cyclists (one rehydrating, the other not) exercising at 90% of their maximum demonstrated a measurable difference in physical performance as early as 15 minutes into the ride.

Fluid losses during exercise result in a decrease in the circulating blood volume as well as the water content of the muscle cells. And the impact on performance is directly related to the level of hydration (or dehydration). Dehydration is defined as a >1% loss of body weight as a result of fluid loss. Unreplaced water losses equal to 2% of body weight (about 3 pounds for the average rider) impact heat regulation, at 3% there is a measurable decrease in muscle cell contraction times, and when fluid losses reach 4% of body weight, there is a 5 to 10% drop in overall performance which can persist for up to 4 hours after rehydration takes place. Thus it is essential to anticipate and regularly replace fluid losses. And thirst is not be a reliable indicator of dehydration as it takes 0.8 - 2% (of body weight) fluid loss to trigger thirst. **Maintaining plasma volume is an important strategy to optimize your physical performance.**

How much water do you need to maintain a normal state of hydration at baseline (without your daily period of exercise)? For a 70 kilogram adult, about 2500 to 3000 cc per day. This is about 4% of your body weight or in terms of energy expenditure, about 1 cc required for each calorie of energy expenditure per day. If your diet is well balanced, about 1000 cc (4 cups) will come from fruits, vegetables, and other foods eaten. Another 1 cup will be from the metabolism of carbohydrates, and the balance, about 7 cups, should be from fluid you drink.

And if you exercise for an hour or two, add in replacement for losses from sweat and respiration. Under normal environmental circumstances, you will lose 1 - 2 liters of sweat per hour, and in the heat this can be as high as 4 - 6 liters per hour. And respiratory fluid losses are not insignificant. Up to 60% of overall fluid loss can be via the lungs - which means that even swimmers can get dehydrated.

What are other factors, besides exercise, that can influence your fluid needs (and if not replaced, exacerbate dehydration)?

- Caffeine - if you are a regular, daily caffeine user, your body will adapt to its diuretic (water losing) effects. On the other hand, if you have been caffeine free for 5 days, and then drink the equivalent of 6 cups (642 mgs of caffeine) over a 24 hour period, you will induce a negative fluid balance of nearly 0.8 kg (equivalent to 3 cups of water).
- Alcohol - this will decrease ADH secretion and allow increase loss of water via the kidneys. For every 2 drinks, you should take an additional 1 cup of fluid per day.
- Environmental factors - heat, humidity, and altitude

For those who practice the philosophy "if a little is good, a lot is better", it should be mentioned that there are risks associated with over correcting the fluid losses of exercise. There have been reports of hyponatremia (low blood sodium concentration) leading to seizures in marathon runners who over replaced sweat losses (which contain both salt and water) with electrolyte free water alone. **This is rarely a problem for cycling events of less than several hours duration (except under extreme environmental conditions of heat or humidity)** and becomes an issue only for events lasting more than 5 hours.

Under normal conditions, you should be drinking a minimum of 4 to 5 ounces of fluid every 15 minutes and should aim for 1 to 2 standard water bottles per hour. When extreme conditions of heat and humidity are anticipated, the following strategy may be of additional benefit:

- drink 20 oz of cool water 2 hours before exercise
- 8 to 16 oz 30 minutes before
- and then 4 to 8 oz every 15 minutes on the bike

If you want a simple measure of the effectiveness of your personal hydration program, weigh yourself before and after a long rides (without clothes to avoid inaccurate weights from sweat soaked clothing). A standard water bottle (20 ounces) weighs about 1 1/4 pounds - or a pound of weight equals 16 ounces (1 pint;2 cups) of fluid; a quart (4 cups) is 2 pounds. This will enable you to tailor YOUR OWN replacement program.

Additional tips:

- **Hydrate before, during, and after the ride** - force yourself to drink as thirst alone will not reflect complete rehydration, so learn to drink *before you are thirsty*. Using a CamelBak or similar device on long rides will eliminate worries about stopping and possibly losing your group. Watch the color of your urine, if you are doing a good job on replacement it should be colorless.
- **Don't skimp when using a sports drink** - don't assume that because they contain electrolytes and carbohydrates you don't need to drink as much. And the sweet taste often keeps you from drinking, so take an extra bottle of plain water to alternate.
- **Keeping liquids cool has been shown to increase intake on a ride** - either add ice the day of the ride or freeze half a water bottle of fluid the night before and top it off with water from the tap or extra sports drink just before the race.
- **Weigh yourself before and after the ride** - most of your weight loss will be fluid (2 pounds equals 1 quart or "a pint's a pound"). A drop of a pound or two won't impair performance, but any more and you need to reassess your personal hydration program. A gain of more than 1 or 2 pounds suggests you are compensating. This is an especially important strategy in hot weather where fluid losses can easily be several quarts an hour.
- **Wear the right clothing** - light colored to reflect heat; a loose weave jersey; shorts made of one of the new "wicking" materials.
- **Wear your helmet** - modern well vented helmets funnel the wind onto your head and are actually cooler than your bare head, and the helmet material can act to insulate your head from the heat of the sun's rays.

Do electrolyte drinks (those containing minerals such as sodium and potassium) provide an advantage over pure water alone? **Not for rides of 1 to 2 hours.** When two groups exercised for 2 hours at 67% VO2 max (with average fluid losses of 2300 ml) there was no advantage to rehydrating with electrolyte drinks versus water alone. But as large volumes are needed for rehydration in long events, palatability and digestive tract tolerance are important in the selection of your replacement fluids. And for some riders electrolyte drinks are easier to

consume. For longer rides, especially over 5 hours in duration (100 miles) or in conditions of extreme heat and humidity, using electrolyte containing sports drinks for sodium replacement helps to prevent dilutional hyponatremia.

In extreme conditions you might consider adding a pinch of salt to each water bottle of electrolyte replacement drink. For example, gatorade doesn't contain much sodium. This will help to prevent hyponatremia. In the same way, salting your food liberally the day before a hot-weather ride can help and may prevent cramps in susceptible individuals. But if you are any type of sodium restricted diet, check with your physician to make sure that adding salt isn't a health hazard for you.

How about carbohydrates? Two hours is the point at which carbohydrate supplements will consistently improve your performance by supplementing your internal glycogen stores. Cyclists can drink large volumes while competing and in extreme events, such as the Tour de France for example, competitors have been able to replace up to 50% of their energy expenditures drinking 20% carbohydrate solutions at a rate of 2 to 4 quarts an hour. If you'd like, you can calculate your exact Caloric replacement needs based on the duration and average speed of you ride. For a rough estimate, you need approximately 1/3 gram of carbohydrate per pound of body weight per hour to replace Calories expended.

Certain carbohydrate containing liquids are more quickly emptied from the stomach and thus the sugar they contain more quickly absorbed into the bloodstream to be delivered to the muscles as an energy alternative to muscle glycogen. Drinks using glucose polymers can deliver additional Calories per ounce of fluid while remaining iso-osmotic).

The temperature of replacement fluids MAY impact the rate of stomach emptying - colder liquids empty more slowly and increase the potential for nausea and delay in getting the electrolytes, water, and glucose into your system. On the other hand, in certain situations, cooler fluids may be more palatable and help to keep you cool (a positive for a ride in extreme conditions). The balance point for drink temperature depends on your personal physiology and the ride conditions, so **no absolute recommendations as to the "best" temperature can be made**.

The same considerations apply to post ride drinks. If you are under time constraints to get back to work, a cool fluid can help you cool down more quickly and cut down your "sweat time". NO studies have confirmed a benefit of fruit drinks (which contain fructose) over glucose drinks. Although fructose requires less insulin to enter muscle cells, it does not appear to provide a performance advantage for cycling. Taste alone is the only advantage.

For many years it was believed that a 2.5% concentration of glucose or glucose polymer molecules was the maximum tolerated without delaying gastric emptying and causing nausea. However a recent study, in cyclists, demonstrated normal gastric emptying with 6 to 8% solutions, and nausea occurred only when concentrations were pushed above 11%. The old standbys - apple juice and cola drinks - have a sugar concentration of around 10%. Although glucose polymer sports drinks can provide more Calories per quart (concentration being equal) studies have failed to demonstrate a performance advantage of complex carbohydrate drinks over the simple sugar drinks alone (assuming the same total Calories were ingested. The advantage of the polymers is the absence of a sweet taste and nauseating properties of high concentration glucose drinks, which can be a barrier to maintaining an adequate fluid intake. The stomach does have volume limits which for most riders is around 800 ml (approximately 1 quart). this is particularly the case when pushing aerobic limits (gastric emptying diminishes as exercise approaches 100% VO2 max). If larger volumes are forced, nausea and abdominal

distention can result. For reference, a regular water bottle is 1/2 quart, 16 ounces, or 480 ml.and the large ones are 3/4 quart. You should be able to drink at least 2 bottles per hour.

In summary, drinking 1 to 2 quarts per hour of plain water is adequate for rides of 1 1/2 to 2 hours. For longer rides, where the body's glycogen stores will be depleted, carbohydrate containing fluids take on increased importance (glucose containing liquids can deliver calories from the mouth to the muscles in as little as 10 minutes as compared to solid foods and energy bars which empty more slowly from the stomach). In most individuals, an 8 to 10 % concentration is the optimal. Glucose polymers provide the ability to increase total calories per quart without risking the side effect of an unpalatable, sweet taste. Aside from palatability, there is no proven advantage over simple sugar (glucose) drinks. **Although there are many commercial drinks available, the old standbys such as apple juice and cola drinks are probably the least expensive per Calorie provided.** In the pre- and post-ride period, the high calorie, easily absorbed, glucose polymer sports drinks do offer an advantage for rapidly building (or restocking) glycogen stores. For those of you interested in saving a few $$, take a look into some ideas on homemade energy drinks.

For longer rides, don't forget the risks of overdoing rehydration with pure carbohydrate (electrolyte free) drinks alone. If you plan to ride more than two or three hours, it's worth considering a commercial electrolyte containing drink, and if you are going to be riding 5 hours or more, it is essential to pace your fluid replacement rate (and keep an eye on your weight during training rides to be certain you are not overcompensating).

SPORTS DRINKS

Commercial sports drinks are the easiest, but are pricey. Often times complex carbohydrates can be purchased in a health food store and mixed at home with a flavor of your choice or used to supplement a current favorite drink.

Maltodextrin is a corn starch molecule which has been broken down into glucose polymers (chains of glucose molecules). When added to water or other drinks, it increases the energy content without the disadvantage of an overly sweet taste and a highly concentrated solution which will delay gastric emptying. It is useful during exercise or as a post ride supplement, but does not make provide any advantages to breads, cereals, grains, etc. as a regular daily energy source.Directions are usually available from the container, but can vary from 1/2 cup in 8 pounces to 3/4 cup in 32 ounces. You may need to experiment to find the best concentration for your personal physiology.

A 16 ounce water bottle (480 cc) of a 7% sugar solution at 4 Cal per gram of carbohydrate will contain about 136 Calories. If you add 1/2 cup of Carboplex (a commercial maltodextrin) you will add another 220 Calories almost tripling the energy density (concentration) of your drink with minimal chances of nausea or other side effects.

OF ADDITIONAL INTEREST

There have been some encouraging studies on the use of glycerol to minimize the negative impact of dehydration on performance. For those interested in a commercial product, try the internutria website.

Except under extreme conditions, electrolytes (particularly sodium chloride or salt) do not need to be replaced along with fluids.

READER'S QUESTIONS

Q. I currently average about 225 to 250 miles a week with a metric century or a full century on the weekends (and 1 or 2 rest days and recovery ride during the week). I have been weighing myself before rides and after and its a little alarming, on average I lose about 4-6 pounds on every ride I take! I just completed a 70 mile with 3 big climbs, in 4:00:59, when I started I weighed 148 lbs when I finished I weighed 142 lbs! I Drank 4 24 ounce water bottles with Gatorade Endurance formula, had two Gels and a cliff bar (oh yeah and had a cliff bar to start for Breakfast at 6am). I drank so much I feel a little gassy toward the end and did not feel better until i burped many times. Is this weight loss normal for a rider my size? Our average temperature in Phoenix when I ride is 92-95, with a little humidity in July-Aug (30-50%); should I be alarmed? Do I need to rethink my whole hydration plan for the whole ride? - C.H.

A. When you lose weight on a ride, you can assume it is water weight - so you were 6 pounds or a quart and a half behind in fluids (a quart or 4 cups = 2 pounds)at the end of the ride. (In ounces, that is 16 x 6 or 96 ounces.) That is 4% of your body weight - which will impact your performance. The bottom line - you do need to rethink your hydration plan.
Over the four hours, you drank 96 ounces or 24 ounces per hour. I think that is about the maximum you can take in per hour (and empty from your stomach). But you may get some additional benefit by drinking 20 oz of cool water 2 hours before exercise and another 8 to 16 ounces 30 minutes before exercise to assure that you are fully hydrated when you start. You might consider trying other sports drinks as sometimes one will agree with your physiology better than another and thus empty a bit more quickly from your stomach. Other strategies would include proper clothing (white to reflect the heat), and I'd also think about switching to a completely liquid diet for the few hours before and during the ride - even the cliff bar may be enough to lengthen gastric emptying time and contribute to the bloated feeling.

Q. Do you know of any recipes for sugar free sports drinks?? My daughter is rotting her teeth, partly because of the dehydration from running, and partly because of sports drinks.? We'd like to mix up something ourselves. - T.

A. Sports drinks provide four things:

1. Water (this could come right from the tap as well.
2. More palatable (so one does adequately rehydrate) - any flavoring would do
3. electolytes (salt being the most common, then perhaps potassium). But unless she is running 5 hour marathons, probably not a big deal.
4. carbohydrate - to replace what is being metabolized anbd which is what works to promote tooth decay. A complex carb migh be less of a problem (carboplex) but anything with simple glucose or sucrose is going to be a problem with a sugar film on the teeth to aid the bacteria which cause decay.

Any flavored water (may are commercially available) would work to provide the fluid and a better taste than just water alone. But if she is exercising more than 2 hours she will start to run out of carbs. How long does she run?? Does she brush immediately afterwards (which might help a bit to eliminate the sugar rich coating on her teeth).