Bicycle Medicine & Science

The true method of knowledge is experiment.
William Blake, 1788

What's New This Past Year

What's the latest medical and scientific info about bicycling?

Do you read the ad copy in the magazines to figure out what might be worth trying? Do you look to the pro athletes, who are sponsored, and figure that if they do it or use it, it must be great? Do you ask your friends, or just spend your time, effort or money and try everything yourself?

For most of us, it's a combination of all of the above, plus a little hope. And, unfortunately, that little hope is what lots of companies cash in on when they manage, for example, to sell us plain old water at a couple of bucks a gallon or more.

There's another way—the scientific way. Looking at what studies/experiments really show.

It's common for studies to show apparently conflicting results. For example, over the years bicarbonate loading and caffeine have been accepted as improving human performance. This year new studies have questioned that conventional wisdom. Each study often adds just a little piece to the puzzle. It's important not to put too much faith in any one study.

I've written similar articles the last few years. Here's my spin on some of the published information on bicycling-related medicine and science that came out in 1998.

Nutrition

Carbohydrates: Ingested prior to weight workouts, they didn't make a difference. But carbs did help cycling performance during prolonged or intermittent high-intensity workouts in two studies.

Carbs didn't improve performance when ingested before a 30-minute time trial. But they did in a 100K TT.

(Carbs in solution may not be necessary for events as short as 30 minutes, but an hour or longer—they'll probably be invaluable.)

Carbs with a high glycemic index (quickly absorbed) are thought to increase insulin levels, and therefor lower blood sugar and worsen performance. This was found to be true in two studies, not in a third. And high-glycemic pre-event carbs didn't worsen performance if carbs were also ingested during exercise.

Glycogen loading: Glycogen depletion through exercise improves effectiveness of glycogen loading. Once loaded, the effect lasts for 3 days, but not for 5.

Fat: Eat more fat to improve fat use during exercise? The conventional wisdom is that what you eat has no effect on what energy source you use during exercise. (The use of carbohydrates or fats is thought to depend only on intensity level.) Defying conventional wisdom, a study of cyclists found that those consuming a diet consisting of 70% fat for 15 days did use more fat during work at 70% of VO2 max than those who consumed a diet consisting of 30% fat.

(And therefore, perhaps, these subjects were able to spare glycogen. Of course, one of my favorite aphorisms is: "There is no point in increasing fats to spare glycogen if the net effect is that you have less glycogen to spare.)

MCTs: Medium chain triglycerides—partially broken down fats—are thought to be an energy source that may spare glycogen. They've been popular the last few years, but may be on the way out. They were of no help in a few of studies that examined their effectiveness.

Branched chain amino acids: The theory is that these broken-down proteins may help improve endurance performance by affecting brain serotonin levels, or improve immunity, as tested by certain "immunity" cells or biochemical markers. Well, not so in six studies this year.

Hydration: How much dehydration can be tolerated without adversely affecting performance? One study found neither 2% nor 4% dehydration adversely affected performance. Another study showed conflicting results—it showed that as little as 2% dehydration worsened performance.

One study found that carbonation helped rehydration. As did flavoring, a little salt, and carbs.

Sodium: Long distance endurance athletes—those active for more than six hours—may have problems maintaining blood sodium. This problem is being increasingly recognized, and thought to be common in slow marathon runners, marathon walkers, Ironman triathletes, and ultra cyclists. Studies have shown more than 10% of participants in such events may have seriously low sodium levels that may led to weakness, convulsions, and death. Salty foods and drinking no more than 1 quart per hour may help prevent problems. (Although sweat rates may be higher, the body rarely absorbs more than one liter per hour. It may not be possible to prevent *some* dehydration.)

Antioxidants: Some say these substances may allow an increase in training intensity. Not so according to one study reported this year.

Ergogenics

Performance-enhancing substances and devices.

Should these be banned? Should one be allowed to take something to make one stronger or go faster? It's not a black and white issue, and not a question that I'll discuss here. But many researchers are looking at these substances.

Studies this year showed that about 50% of college students take or use aspirin, caffeine, rubdown ointments, sport drinks, and/or vitamins to help with sport performance. And about 80% of Navy Seals take nutritional supplements.

Caffeine: Was shown to improve lactate elimination from muscles in one study. Didn't affect peak torque in another. Or peak power, mean power, or Wingates in yet another. Didn't affect glycogen use in a 2-hour exercise bout.

Creatine: I read about 10 studies this year. Overall, creatine was not much help. Ingestion of carbs with creatine is thought to perhaps add to creatine's effectiveness: Not so in a study that specifically looked at this question.

A few, but not all, anaerobic activities examined did show a benefit from creatine. Associated with kidney disease in one patient reported this year.

(Summing up several years of research: Creatine *may* be helpful in some pure strength activities, such as weight lifting and possibly, track sprints. It's of doubtful benefit in endurance aerobic sports such as road riding or mountain biking.)

Glycerol: Not much help in a couple of studies this year.

Bicarbonate: No effect in 800-meter running. In another study, no effect on muscle glycogen use or muscle lactates. In another, no effect on intense endurance-exercise performance.

Pyruvate: No effect on maximal exercise.

Breathe Right external nasal dilator strips: No help in three studies this year. Helped in a study of hockey players.

(That's about 20 studies that have shown no benefit over the last few years, and a couple that have—primarily in intermittent activity sports were athletes are subject to overheating. Some have postulated that increased nasal airflow may result in brain cooling.)

Endurox: This is a proprietary product that claims to increase fat metabolism, decrease lactate accumulation, heart rate, and fatigue during exercise. It didn't help performance in two studies that examined its effectiveness.

Citrulline malate: This is an amino acid found in watermelon and milk protein. Improved aerobic capacity was found in one study.

Women and the Menstrual Cycle

Most studies have shown no measurable change in performance during the menstrual cycle. One study this year showed that women have less power during their menstrual cycle. Another found no differences, and also looked at women taking oral contraceptives—and again found no effect.

(Over years of coaching I've found that about 90% of women feel that they race better when not menstruating, and about 10% feel their best performances come when they are menstruating.

I don't feel that oral contraceptives help or hurt performance in most of the athletes who use them—but they usually allow for the planning of menstruation, reduce blood loss, and, of course, provide effective contraception.)

Colds and Training

Two studies this year looked at the effects of respiratory illness on physical performance. One found no difference when athletes continued to train. Another found inactivity during a respiratory illness was associated with a decrease in VO2 max, but not strength or endurance, and only for a few days after illness.

(My philosophy: Avoid training with fever or chest symptoms. Otherwise, train—if you feel like it.)

Climate

Heat acclimation is commonly said to take 10 days of 2 hours daily heat exposure. In one study this year, 9 days was sufficient for women but not girls.

Does precooling before hot events help? Not in a study of triathletes who swam for 15 minutes and cycled for 45.

Expanding blood volume with intravenous solutions pre-exercise didn't help reduce the heat stress of exercise in one study. In another, those dehydrated before exercise began suffered reduced performance.

(One interpretation of this study: If you are already hydrated, it's doubtful that "superhydration" with glycerol or other products will improve heat tolerance.)

Another study looked at the influence of types of clothing on performance in the heat. Performance wearing Coolmax was significantly better than the polyester and cotton.

Biomechanics

A study of mountain bikers showed that pedaling action is significantly different on road vs. mountain bikes.

(One message of this study might be that when mountain bikers train a lot on the roads, they should do so on their mountain bikes.)

A study looking at noncircular chainwheels found no advantage over circular chainwheels.

A study looking at optimal cadence found a greater oxygen cost with cadence at 80 vs. 50, but that this difference disappeared as power output rose.

(This is the accepted thinking. More to the point: its probably pedal force perception that increases cadence in high power output cyclists)

Subjects were able to produce more power on recumbents than traditional bikes—probably because the muscles at the resultant joint angles were more effective. Similarly, another study showed riders using bikes with shallower seat tubes were able to produce more power.

(Another way of saying a similar thing: On a regular road bike you have more power sitting upright than in a bent-over aerodynamic position.)

Having aerobars level or pointed up 40 degrees made no difference in lung function/ventilatory dynamics or heart rate measurements.

Do you participate in *Spinning* classes? Standing or climbing increased metabolic demands in most subjects in comparison to seated riding.

(Real world message: Sitting rather than standing when climbing may save energy.)

Training

Four-minute and 30-second intervals were more helpful in improving 40K time trial performance than 1-minute, 2-minute, or 8-minute intervals.

Peaking for an important event using a tapering program? One study found tapers longer than 2 weeks lead to significant detraining.

One-legged plyometric training was more effective than two-legged plyometrics in improving vertical jump. (I don't endorse plyometric training for most cyclists. I feel the benefits are marginal and the risks of injury great.)

(One interpretation—confirmation that one of my favorite training methods—one-legged riding—may be helpful in achieving specific positive training adaptations.)

Slightly varying power outputs (by about 5%) in hilly or windy time trails (putting a little more into the hill or the wind) may result in improved times according to a study performed this year.

Time of day didn't influence strength performance or training gains in a couple of studies performed this year.

Some coaches believe that high-intensity training helps anaerobic fitness, but negatively impacts aerobic fitness. Although the mechanism is not well understood, one study this year came to a similar conclusion.

A study this year showed that the losses of cardiovascular fitness from 2 weeks of inactivity are completely regained after two weeks of retraining.

Runners who ran up and down hills improved fitness more than those who trained only on level ground, even though the volume and intensity of training was the same. (Perhaps there's a corollary for cyclists.)

Exercise-Induced Bronchospasm or Asthma

It's been known for some time that warm-up can be especially helpful for those with EIB. A study this year showed that interval warm-ups to about 90% of max HR are even more helpful than steady-state warm-ups to about 75% of max HR.

Altitude Training and Competition—Manipulation of Oxygen Content of Air

High-low training—resting at altitude and training at sea level has again been shown to be a good training strategy for improving sea-level performance.

This strategy may result in the positive adaptations to altitude (more red blood cells, improved muscle transport of oxygen) without the negatives (lower VO_2 max and loss in anaerobic power with continuous altitude exposure).

Many past studies have looked at non-elite athletes. This time elite runners showed improvement with this strategy.

Technological approaches allow one to continue to live at sea level and sleep in either a personal altitude chamber or altitude tent. Olympic pursuit medallist Shaun Wallace has this year developed and marketed such an altitude tent.

I've tested both altitude chambers and altitude tents. Although most riders might expect about a 1% to 2% improvement in performance times, not all will respond. (A 1% top 2% improvement can be a lot—about one minute per hour.)

For a complete review of this subject see the review in the Sport Science Webjournal July issue, in the training and technology section. The web site: www.sportsci.org.

Interval training on cycle ergometers with oxygen supplementation didn't improve fitness in one study of women cyclists performed this year.

Tailwings Skinsuit

A new skinsuit with gussets running from the back to the arms may reduce wind resistance for time trialists. Preliminary unpublished research has shown about a minute improvement in 40K time trial times.

Delayed Onset Muscle Soreness (DOMS)

I've talked about this problem before. Researchers spend a lot of time investigating this problem because sore muscles—sore especially from eccentric exercise—prevent high-level performance in athletes

A study that looked at the effect of a stretching program found stretching didn't help prevent DOMS.

Another study may help elucidate a cause of DOMS: a neural factor in fast-twitch fibers.

This year again, studies which examined the effectiveness of anti-inflammatories (NSAIDs) in reducing DOMS were mixed: some found they helped, others found they didn't.

The Accusport Blood Lactate Analyzer

This is a hand-held device that measures blood lactate. It's similar to a device that diabetics use to measure blood sugar.

One formal study this year found Accusport values consistently higher than the results obtained by standard laboratory equipment.

(Although there's a rational for its use in training, I'm not convinced that it would have much value even if it worked. I've tested this device on a number of occasions. Others and I have found a number of problems—including resting lactate results in the "anaerobic" range. I've found the device neither accurate nor reliable.)

Psychology

Relaxed runners (those who participated in relaxation programs) were shown to be more economical—they ran the same speed at lower heart rates.

Pessimistic athletes had higher anxiety compared with optimists—but showed no difference in performance. (Perhaps the message here is that there is no need to worry about worrying about a bad performance—you'll do the same anyway!)

A study of 13 runners in a high-volume running program showed an increase in negative mood states. (In other words, this study showed that too much training results in depressed athletes.)

Aromatherapy in one study and music in another had no effect on performance.

Cyclists were fooled in a study that looked at the effect of perceived rather than actual distance pacing strategies in time trialists. Subjects thought they'd ride a certain distance, and were given feedback about what percentage of the ride was left, but actual distances were 15% greater or 15% less than they were told. Riders were able to hold efforts for the longer distances. (So—maybe you can really go a little bit harder for a little longer than you think.)

Conclusions

As I usually find, there's a whole lot of interesting science out there, but only a limited amount of information that will prove helpful to improving performance. There really isn't much revolutionary or new stuff that's going to make you a better rider beyond what you already knew: Training is still the key.