Chapter III

Carb Conundrum

Carbs are not required when physically inactive

The human body does perfectly fine without eating carbohydrate foods. There are studies nearly a century old [1-3] showing that tribes living in the Arctic eating only animals get in the range of 15-20% carbohydrate from glucose stored in the tissues of the animals. With over half the calories coming from fats, less than one-third is protein. Plants are higher in carbohydrate than animals, so a truly carbohydrate-free diet, whether plant or animal based, could only be achieved with synthetic foods having had the carbohydrate removed. Regardless of the technical impossibility of a zero-carb diet, it still remains true that carbohydrate foods need not be explicitly consumed to stay healthy.

The Institute of Medicine (IOM) reviews the scientific literature to establish recommendations on human nutritional needs roughly every decade, called the Dietary Reference Intakes (DRIs), which include the Recommended Dietary Allowances (RDAs). From their most recent review [4]: "The minimum amount of carbohydrate required … is determined by the brain's requirement for glucose. The brain is the only true carbohydrate-dependent organ … Normally, the brain uses glucose exclusively for its energy needs…110-140 g/d in adults." This corresponds to 440-560, or approximately 500 Cal of glucose per day. The IOM estimates that an over-night fasted adult is producing blood sugar from the liver at 2-2.5 mg / kg / d or ~250 g of glucose / day. Half of this comes from liver glycogen (glucose storage). The other half comes from the liver's production of new glucose made mainly from glycerol, which is the backbone to which fats are attached in triglycerides.

A diet low in carb depletes liver glycogen, forcing the liver to produce more glucose from scratch. But production from glycerol is rate limiting, so amino acids are used to make up the difference. The amino acids come mainly from breaking down muscle tissue, stimulated by the stress hormone cortisol in response to a low blood sugar. Eventually, after 1-3 days of low carb consumption, the brain reduces its glucose demand by shifting to using more ketones. This shift occurs when the liver's glycogen stores deplete sufficiently for it to signal the brain through the vagus nerve [5], in effect telling the brain to stop eating up muscle and use ketones instead to spare the body's lean tissue. Ketones are made from fats, most being attached to glycerol in triglycerides. Once the brain has shifted to ketones made from fats, the other half of its fuel is still glucose made from glycerol, making triglyceride the entirety of the brain's fuel, with the liver making the necessary conversions first. Exercise robs the blood sugar produced by the liver, and the brain cannot use ketones exclusively.

Exercise combined with low carb loses lean tissue and health

During the time that liver glycogen depletes to stimulate the brain's shift to ketones, the IOM estimates that a production of roughly 80 grams of glucose from 160 grams of muscle protein every 24 hours, meaning a loss of roughly 1/3 pound of muscle each day until in ketosis. A quarter-pound beef patty is less than the amount of muscle you lose each day transitioning to ketosis, dropping metabolic rate profoundly. It would take more than a week of intensive strength training at the level of a strength athlete to recover what is lost in just one day of carb starvation.

Meta-analysis (combining all the research) of ketosis in humans shows that the brain demands at least 1/3 of its fuel to be glucose even in the deepest ketosis thus far studied [6]. Some neurons use glucose three times more efficiently than ketones [7], so a severe glucose shortage would reduce the function of some neurons types, shifting brain function to those able to use ketones easier. Exercise combined with low-carb dieting risks symptoms of overtraining [8], which are similar to major depression [9], including suppressed endocrine and immune system function. Apparently, robbing what little glucose the liver can produce for the brain during ketosis by exercising compromises brain function to shift both it and the entire body into a slippery slope of shut down. Even less than two weeks of hard exercise with low-carb intake drops both performance and people's sense of wellbeing [10]. A model bringing these data together might: Exercise lowers blood sugar which, if already low from low-carb dieting, reducing brain (and therefore the whole body) function and stimulates cortisol release to break down muscle even when the brain is fully adapted to ketosis because some neurons demand glucose.

If You Exercise, Carb Timing is Critical

The absorption rate of glucose into muscle increases during muscle contraction independent of insulin. So during, and more importantly for a short ***after*** exercise, glucose is cleared out of the bloodstream faster than usual. To meet this demand, a fast-digesting glucose food should be consumed right after exercise. As long as muscle glycogen (glucose storage) is low, the absorption rate into muscle is higher than usual, but the ***highest*** glucose absorption rate from active muscle contraction will be mainly gone after about an hour. This means half of muscle-contraction stimulated glucose absorption is lost in less than half an hour, and half of the remainder in less than another half hour. The fueling rate is back to being mainly insulin dependent at roughly 1 hour. Using insulin to get carbs into muscle means also sending some of the carbs to fat (a necessary evil of insulin). Right after exercise, the dependence on insulin would be minimal, and the delivery of the carb to muscle maximized.

To address this problem, the glucose would be consumed within 10 min, or at most 20 min. Depending on whom you ask you'll hear 30, 45, or 60 min, all being correct since it takes that long for fueling to return to being mainly insulin dependent. But my experience is that people who ask the question are not achieving their desired weight loss and other exercise goals in part because they wait longer than 10 min. For those who don't care, waiting an hour is fine, but for those struggling discover benefits to their exercise efforts, I would not even wait 10 minutes. The moment hard exercise ends, before a long cool-down, stretching, showering or even leaving the track or gym, drink water and eat a glucose food.

The Recovery Window is Mainly for Glucose

Glucose foods are tubers (yams, potato) and cereals (rice, corn and other grains, such as oats, wheat and quinoa). Foods made from tubers or cereals, such as chips, crackers, bread, dry cereal or granola of course also deliver mainly glucose. Fruit is the wrong sugar right after exercise, and protein is not sugar at all. Protein after exercise is a good idea, but does not resolve the carb conundrum. Only immediate glucose food restocks exercise glucose losses. Without that, muscle will keep your blood sugar too low for hours or even days (depending on how low-carb your diet) without the liver being able to keep up with the combined glucose demand of your muscles and brain. The ketone-adapted brain will then stimulate muscle breakdown to make up for the exercise blood sugar losses. Instead of the exercise stimulating a higher metabolic rate and fat loss, it will reduce muscle mass and therefore metabolic rate, losing its fat-loss benefits over time.

It's Less of a Conundrum When Younger

When starting an exercise program and cutting carbs the results are at first fantastic, but as soon as fitness levels go up so that the workouts are a bit more intense, the blood sugar drop is worse and the vicious cycle begins. This issue gets worse with age since natural hormone production slowly drops as we get older. When younger, exercising hard and cutting calories seams more effective for weight loss (although not healthy), but years later the body refuses to cooperate since the hormone levels of youth are no longer there to protect muscle, making us more dependent on properly coordinating exercise with nutrition. Genetics, poor sleep, high stress, and poor nutrition can all converge to derange hormones, so even a young person can suffer from a low metabolic. Muscle loss and higher body fat from exercising is therefore possible at any age depending on the intensity of exercise and psychological stress, and the quality of your nutrition and sleep. Movement, mind, food and sleep converge with our genetics to establish our metabolic rate from moment to moment.

Flip-Flopping Between Carbs After Exercise & Later Veggies

Healthy weight loss is not mainly focused on calorie balance. Instead, it focuses on raising metabolic rate, starting with getting what you are eat into your lean tissues instead of body fat. A fast-digesting glucose source right after exercise restocks muscle so that muscle leaves blood sugar alone later on, making a low-carb diet healthy. After hard workouts, the next meal will need some carb as to continue the muscle glycogen recovery, but with vegetables to slow their digestion. Carbs after that would be entirely optional and always with crunchy vegetables.

This means flip-flopping between a high-carb (**sports** nutrition) mind-set right after exercise, and then shifting to a low carb (**health**) mind-set afterwards, with one meal in-between having intermediate carb level after a particularly hard workout. Ironically, without the sports nutrition mindset right after exercise, the low-carb healthy eating will actually hurt you because combined with hard exercise it depletes the body excessively. When we drive our car we have to re-fuel the tank…when the car just sits, the tank stays full and needs no fuel. Applying the same common sense to our body allows it to keep running, driving our metabolic rate up instead of destroying it.

Fast-Digesting Glucose After Exercise is "Essential Garbage"

Eliminating or restricting things we like is not inherently sustainable. Timing crunchy vegetables with carbs is critical to eating foods we like that digest fast in order to slow their digestion. This is the opposite of the fast-carb approach right after exercise. Since fast-digesting (processed) carbs are not healthy at any ***other*** time (particularly eaten by themselves), you might think of them as "essential garbage" right after exercise. But you can still eat them at other times with a large vegetable load. If you exercised yesterday, waking blood sugar, liver glycogen and muscle glycogen are lower than usual. This makes a bit of any carb calories as soon as possible after waking essential as well.

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