Monitoring Your Cheeseburger Threshold

Like a car needs gas, our bodies need fuel to perform. And in my case, that fuel comes in the form of lots and lots of cheeseburgers. Maybe not the best choice in the world in terms of all-around health, but in terms of providing energy, they work just fine. Here’s why:

Whether you walk or run, go slow or fast, you’re going to burn a mix of fats and carbohydrates. You also get a small amount of energy (about 5%) from protein, but while protein is very important in rebuilding the muscles, blood cells, etc., that you break down during exercise, it is of limited importance in providing energy. So 95% of your metabolic energy comes from the fats and carbs in your Butch Cassidy’s Wild West Burger.

Despite their bad reputation, fats are a great fuel source. They are energy-dense (9 calories per gram for fats, vs. 4.5 calories per gram for carbohydrates) and our bodies are very good at storing them. (Not that that’s entirely a good thing, with “bikini season” fast approaching...) Fats are also “clean-burning,” producing only water vapor and carbon dioxide as by-products of combustion.

The downside to fat metabolism is that you can only burn fats in the presence of carbohydrates and lots of oxygen. So, if you “hit the wall” in a marathon and run out of carbs, you can’t access fats either, even though you may have a lot of fat “stored” around your mid-section. Fats can be tough to access in shorter races as well. If you’re running or walking very fast, you won’t be able to take in enough oxygen to burn a lot of fat so most of your energy will have to come from carbs.

That doesn’t sound like a big deal, but it is. The up-side to carbohydrates is that they burn just fine, and they are very versatile; you can burn carbs whether you’re going slow, fast, long or short. The problem is, if you burn carbs without a lot of oxygen (when you’re going very fast and can’t take in enough oxygen to meet your energy requirements) there are some nasty by-products, most notably lactic acid. Lactic acid is not inherently “evil,” but any time you raise the acidity in your muscles they will contract more slowly and you’ll feel “dead-legged.”

As you go faster and faster, you need more and more energy. To create this energy you need to mix more and more “cheeseburger bits” (fats, carbs and protein) with oxygen. It’s hard to measure cheeseburger bits on the go, so physiologists like to use a proxy, namely oxygen consumption. It’s pretty easy to measure O2 consumption (and CO2 exhalation) in a lab on a treadmill, but not so easy on the track. So we use another proxy: heart rate. It doesn’t make sense for you to suck in more and more oxygen if it doesn’t go anywhere, so your heart-rate increases in lock-step with your respiration rate to get that additional O2 into your working muscles. So by measuring heart rate we can get an idea of how much energy (cheeseburger bits and Oxygen) we are using, or in simple terms, heart rate is a very good (and easy to measure) gauge of how hard we’re working.

Unfortunately, oxygen uptake can’t increase forever. Your lungs are only so big, so at a certain point you just can’t take in any more oxygen. This point is known as your VO2 max (V for Volume, O2 for Oxygen). Oxygen uptake starts to level off, then “flat-lines” at VO2 max.

Oxygen uptake isn’t the only thing to level off at higher speeds. Heart rate also starts to level off as you approach VO2 max. It doesn’t make sense for your heart rate to continue to rise indefinitely, because you’re not going to pump more oxygen through your body than your lungs can take in. So you get a leveling off of heart rate as well as you approach maximum heart rate.

But... even though respiration rate and heart rate start to level off, that doesn't mean that your legs will want to "level off" their turnover rate. You want to be able to run or walk faster and faster and faster. The problem is, it takes more and more energy to do this, and again, energy = more and more cheeseburger bits and oxygen. So, you hit a crossroads. At a certain point your increasing speed crosses the line where you're not able to take in enough oxygen to meet your energy requirements aerobically, so you start to produce more lactic acid.

At lower speeds your body is very good at breaking down lactic acid. In fact, all lactic acid is is incompletely burned carbohydrate, so if you add a little more oxygen it'll be converted into energy (in the form of adenosine triphosphate (ATP) for any of you that are storing your 7th grade biology texts in your heads like I am...). But if you wind up asking your muscles to create more energy than they can provide aerobically ("with oxygen") you'll start creating energy anaerobically ("without oxygen") and lactic acid production will suddenly exceed your body's ability to break it down. This is your "lactate threshold." Stay below this threshold, and lactate levels in your blood will stay relatively stable; exceed this threshold by a little bit and lactic acid will start building up in your muscles and blood. Exceed it by a little bit more and lactate concentrations will rise even faster (since your rate of oxygen uptake has leveled off but your energy needs have NOT leveled off.) Exceed threshold by a lot (1 minute per mile or more) and things will get really really ugly, really really fast. That's the feeling you get when you start a 5K race way too fast. Three or four minutes into the race it's all over with. You've flooded yourself with lactate and the only way to recover is to stop, or slow waaaay down for a long time to allow your muscles to get more oxygen in there to break down the lactic acid. (To be precise, "lactic acid" is what you find in your muscles; "lactate" is what you call it when it's in your blood stream.)

Unlike during 5ks and 10Ks, lactate accumulation isn't the problem in a marathon, it's the fuel mix you're burning. The faster you go the more carbohydrates you burn. Fats are pretty much unlimited, (dang, just LOOK at this gut!) but carbs are very limited—you can only store about 3,000 calories worth at the very most, and that may or may not be enough to get you through a 26.2-mile race. Go a bit slower and you burn a higher percentage of fats, and that will allow you to finish with no problems at all.

TRAINING (doing those long days) will do even more for you. Endurance work builds capillaries—little tiny blood vessels that get the oxygen from the blood stream into your working muscles. More long workouts = higher capillary density. But that's not all. Long days also increase the hemoglobin concentration in your blood, and increase your total blood volume. Hemoglobin is what bonds to oxygen to carry it through your blood stream, so by doing your long days you'll carry more oxygen to your working muscles, and that means faster running/ walking without burning up lots of carbohydrates. So if you're training for a marathon, do those long days, and keep your heart rate relatively low by not pushing too hard in the early miles. This will turn on your "fat-burning engine" and that will keep you from hitting the wall in Nashville, San Diego, or Anchorage. And if you're planning on racing shorter distances, your long days will allow you to get more O2 into those muscles during the Lung Run or Home Run Trot, and that will allow you to go faster without flooding yourself with lactic acid.

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*Back to homepage
