Physics, Physiology and Food

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Whenever we think about "diet" we almost always think of losing weight. Pritikin, Atkins, Weight Watchers, Jenny Craig, South Beach, SlimFast, Nutrisystem, Learn, Paleolithic, Zone – diets galore and hype galore. All touted to provide you the means to a "healthy" weight, what do all these diets have in common … besides costing you money if you buy the books, supplements, or the pre-packaged special foods? They all do three basic things: (1) they modify the composition of your diet (limit your food selection), (2) either directly or indirectly limit your caloric intake, and (3) expect you to exercise as part of your diet. So they all are all basically variations on the same theme but there is a tremendous amount of controversy about which diet is superior. Currently, the biggest debate in the media and between health academics is low-fat versus low-carbohydrate. Who would have ever guessed that a simple manipulation of a couple macronutrients would be such of point of contention with exercise professionals, physicians, the media, and the public in general? Who would have thought that the tremendous amount of federal and private funds expended on nutrition and obesity research would create such a wealth of wrong thinking? Wrong thinking? How could I even suggest that some of the best minds in obesity research aren't producing useful information? They are forgetting basic physics and they are forgetting to consider the basic reasons why we eat. We'll come back to this latter consideration in a bit as is particularly relevant to eating for CrossFit.

But first lets consider the current debate raging about dietary composition and simple laws of physics. Variations in dietary composition that characterize commonly researched diets make them easy to differentiate and easy to describe, but does the composition of your diet really matter? Whether anyone likes to admit it or not, for weight loss probably not, it's the total amount of energy consumed (calories) that matters. And this is not an arguable point. There is this pesky little physical law of the universe that forms the basis of all weight loss and weight gain. The second law of thermodynamics states that energy cannot be created nor destroyed, it must be conserved. In other words, energy that enters a system must equal the energy that remains in the system or leaves the system. Or in even more direct words, the amount of calories you eat and drink must equal the amount of calories stored in the body or expended through metabolism. Nowhere in this inalterable equation is the quality of the diet or composition of the diet a consideration, only the math of caloric deficit or surplus. Its old, but the phrase "calories count" is still as viable today as it was when the first diet hucksters tried to cash in with it on the vane American obsession with skinniness. So, with the second law in mind, if you eat the food pyramid and keep the numbers of calories you eat to less than you expend, you can lose weight. If you go low-fat, you can eat and drink nothing but Choco Cap'n Crunch and Coke in appropriate quantities and you can lose weight. If you go low-carbohydrate, you can eat and drink nothing but bacon and diet Coke in appropriate quantities and you can lose weight. If you go low-protein, you're not thinking very clearly but the same energetic relationships apply.

While we don't recommend either of these diets for CrossFitters, it is prudent for trainers and trainees to understand the diets that are receiving the lion's share of media and clinical attention. There is some very simple logic behind both the low-fat and low-carbohydrate diets. The low-fat diet presumes, quite correctly, that since fat is a very energy dense macronutrient at 9 calories (kilocalories to be precise) per gram you can eliminate a significant portion of your caloric intake by reducing how much fat you eat. The average American gets somewhere around 34% of their total dietary calories from fats in food. If this intake were reduced to 20%, it would represent enough of a caloric reduction for someone to lose about a pound a week – if the calories were not replaced with carbohydrate or protein. Even if they were replaced on a gram for gram basis, both carbohydrate and protein contain 4 calories per gram, and that simple replacement would likely net a weight loss of about a pound every ten days or so. If you can hang with the food choices of

the low-fat diet you can effectively lose weight. But high carbohydrate diets have an innate problem that makes compliance with them difficult over the long term. Carbohydrate consumption stimulates insulin secretion (and this happens whether it is a "good" carbohydrate or a "bad" carbohydrate). Insulin stimulates the transport of that newly digested carbohydrate, now in the form of blood sugar, to be moved out of the blood into the various tissues of the body. The inevitable result of insulin action, a reduction in blood sugar, stimulates hunger since hunger is responsive to depressions in blood sugar. You get hungry more frequently on a low-fat diet. That tiny little problem usually dooms low-fat diets to failure and abandonment in a matter of weeks. For a chance at success with a low-fat diet not only do you need to change diet composition, you also need to change how you eat. Instead of three squares a day it is much more effective to eat four or five smaller meals with little snacks between. Spreading the food relatively uniformly across the waking day helps minimize the time between insulin concentration troughs thereby helping to limit in between meal hunger pains. It is interesting to note that in the last decade, the government-sponsored campaign against dietary fat has resulted in a decrease in the percent of fat in the American diet (it peaked out at over 42% a few years ago). BUT the average bodyweight and bodyfat of the average citizen has increased despite the decrease in dietary fat. Oops! Looks like there was a misfire with this magic bullet for health. A blanket promotion of a low-fat lifestyle as a means towards national health does no good if we fail to consider the basic physics of eating – food selection does not contribute directly to weight loss, its calories that count. We may be eating less fat but we are negating that reduction by adding an excess of low-fat foods in their stead.

The highly touted low-carbohydrate diet has some quite clever elements that are biologically effective and promotionally effective. Eat as much protein and fat as you like is one element that almost every one of its practitioners loves. I'm on a diet and I can eat as much as I want? Sign me up! Despite its outward appearance, a low-carbohydrate diet is not a high calorie diet. Two interesting things will initially prevent over-consumption of calories. First, fat is a very satisfying macronutrient. A protein and fatty meal will satisfy hunger more effectively than a high-carbohydrate meal. Second, by severely limiting carbohydrate consumption, insulin secretion is also limited and the dieter will not experience the swings in blood glucose seen in the low-fat diet. With a more consistent level of blood sugar throughout the day, the low-carbohydrate dieter will experience fewer hunger pangs. Less perceived hunger results in a self-selected reduction in calories consumed. So eating as much as you want actually turns out to be less than you normally would eat with a typical American pattern of eating lots of carbohydrates, fats, and proteins. There is a misconception out there that low-carbohydrate diets drop your bodyfat faster and to a larger magnitude than low-fat diets. You do lose "weight" very quickly in the early stages of the low-carbohydrate diet. This is due to the body mobilizing and using its carbohydrate stores when you stop consuming them in your meals. That elimination of stored carbohydrate carries with it an elimination of water weight as well. Anytime carbohydrate is stored in a cell it is stored in conjunction with water. Get rid of the carbohydrate and you will also get rid of the water. The end result being a rapid loss of bodyweight that is composed mostly of stored sugars and water and minimally of fat. But that loss of carbohydrate and water is fast enough and large enough for most dieters to visually perceive a difference in the mirror and on the scales. Success makes you feel good and contributes to staying on the diet longer. Once the initial carbohydrate losses have petered out, the body will then begin to tap into stored fat and the rate of fat loss will increase and be similar in rate and magnitude to that seen in a successful long-term low-fat diet.

Despite all the hype and hyperbole, there is enough research produced to date to demonstrate that any of the aforementioned diets will result in about a pound of weight loss per month. Hey! That's not what the commercials say. Well, hit pause on your Tivo when the diet ads are on and read the disclaimers about the big weight losses shown – "Results not typical" will always be in the small print that gets flashed

across the bottom of the screen for a microsecond. If we really evaluate all the research out there on all the diets it is apparent that small to moderate weight loss is all we can expect to happen with any diet. And we can only expect it IF the dieter persists with the dietary regimen prescribed over the long haul. This doesn't happen. The average diet only lasts a matter of weeks and even the longer term success stories will relapse to gaining weight eventually. So dieting for weight loss seems to be at best a transient and very short term fix for what is considered to be a national health epidemic. This isn't new information. The medical and health professional communities have failed to make progress towards "healthy" bodyweights with thirty years of beating the dead horse of dietary modification. Why do we continue in the futile effort to find just the right dietary intervention for the entirety of the American population? Job security for clinical researchers in obesity? Catering to the endless need for promotional fodder of the political machine in its quest to appear as though they are saving us from certain death? Stop spending my tax dollar on something that you know is doomed to failure. Dietary intervention research siphons off valuable federal research funds that could be more effectively used elsewhere. Sorry for the soapbox session there.

Dietary intervention is not the only possible way to fight obesity. Seems as everyone promotes loudly the energy consumed component of the second law, the "eat less" part, and forgets about the other component, the effective and easily manipulated one, energy expended - exercise. In actuality, the diet industry and at least one government regulatory agency has not forgotten exercise. They do pay a very small, lawsuit minimizing, amount of attention to it. That small disclaimer on every diet ad that says "results not typical" also says "as part of a comprehensive program of diet and exercise". So let's think about exercise for a moment. The medical community, the exercise industry, and even Hollywood has framed everything, eating and exercising, as a means of being skinny, beautiful, and therefore healthy. But skinny is not the primary concern we should have when we eat. How much we weigh is not the important issue here. And beauty being paralleled to health? There is probably nothing healthy about vanity and narcissism. We need to consider function when we consider health. We need to consider our ability to survive and our ability to manage the challenges of our daily lives and recreational pursuits. With CrossFit we consume food and drink to power our efforts at gaining fitness and a better quality of life. When we target physical fitness, everything else usually falls in line over time, including body fat.

We should never blindly follow conventional wisdom, so to best understand what "diet" we need to be on, we need to understand how training controls both the number of calories we need to consume AND how it dictates the composition of our dietary needs. So lets work backwards from conventional dietary prescription methods where how diet affects the body is considered and begin here with how training drives the body's metabolic and dietary needs.

CrossFit programming stresses glycolytic and phosphagenic metabolism. Aerobic adaptations piggyback on top of the adaptations thereby induced. Since glycolytic adaptations requires carbohydrate to be present, phosphagenic adaptations rely in part of high phosphagen foods (meats), and aerobic adaptations involve the oxidation of carbohydrate and fat, it should be immediately evident that powering CrossFit training requires eating a blend of carbohydrate, protein, and fat. So right off the bat, it appears that extremely low-fat and extremely low carbohydrate diets don't meet the nutritional needs of CrossFit. Let's be a little more specific and evaluate the metabolic needs of the three basic exercise modes used in CrossFit training: Gymnastic exercises, metabolic conditioning exercises, and weighted exercises.

Gymnastic activities are usually done with bodyweight and although they are completed in a matter of seconds (a pull-up, a muscle-up, etc.) they are done for many repetitions and for many many seconds. These exercises expend stored high-energy phosphates and tap into stored carbohydrate. Metabolic conditioning exercises are done for up to several minutes and are driven primarily by stored carbohydrate (with a little fat

if the intensity is low enough). Weight exercises in the low end of the repetition continuum are dependent on stored high-energy phosphates but as the repetitions get out into the double digits, anaerobic glycolysis is active and some carbohydrate gets used to power sets. So it is easy to see that we can't eliminate any of the macronutrients from an athletic diet and that low-carbohydrate diets might not be a wise choice to support CrossFit training. In fact, it is well known that low-carbohydrate diets reduce the amount of stored carbohydrate and it is similarly well known that lowering carbohydrate stores in the muscle and liver predisposes trainees to early fatigue. "Diane" can tire your butt out all on her own, you don't need to have your diet helping her.

It is not so easy to see that low-fat diets are not so relevant to fitness, after all doesn't low-fat automatically help prevent heart disease. First off, lets consider fat as a good thing, in the diet and on the body. Just sitting there reading this article you are deriving about 66% or more of the energy you are using to live from fat stored in your body. If we extend that ratio to the average non-exercising American who might be expending 2500 calories per day, 1650 calories are coming from fat metabolism. If we use the average daily protein requirement numbers proposed by the American Dietetic Association (0.8 grams per kilogram of body weight per day) that means that a 165 pound trainee would need to consume 240 calories of dietary protein per day. Simple subtraction provides us the number of carbohydrate calories Joe Couch would then need to consume per day, 610 calories. These numbers hardly paint the picture of the need for a low-fat diet, rather they suggest fat is an essential element of the diet (it has been since the emergence of mankind). And as for the heart disease prevention angle used to promote low-fat diets, most recent comparative research has shown that cardiovascular disease risk goes down similarly with low-fat and low-carbohydrate diets, neither is better than the other. Now lets add exercise into the picture, surely exercise increases the need for carbohydrate? Yes, in fact, it does but how much is the question. A broad assessment of all exercise modalities might indicate that if 400 calories worth of exercise are added to Joe Couch's daily habits, about 300, or 75% of the calories used to power exercise would come from carbohydrate with the other 25% coming from fat. If we add those 300 calories to the 610 calories derived from carbohydrate needed for sedentary existence, that brings us to more than 31% of our total caloric need. That's pretty low considering the 55% plus carbohydrate content pushed by the clinical and aerobic fitness communities.

The final micronutrient for consideration is protein, the building blocks of all structural and metabolic enzyme proteins. When we recover from exercise we don't just replete the expended energy substrates, fat and carbohydrate, we have to replace any broken down structural proteins and enzymes that resulted from the exercise bout. That means we have to match protein intake to protein broken down just to maintain the status quo of fitness. With regular aerobic exercise (of the long-slow-distance ilk) it has been shown that up to 1.8 grams per kilogram of body weight is needed to maintain a positive nitrogen balance. With intense weight training, up to 2.5 grams of protein consumption per kilogram bodyweight is needed to maintain a positive nitrogen balance. A positive nitrogen balance means that you have enough protein building blocks to support fitness gain. With a compromise 2.2 grams of dietary protein per kilogram of bodyweight per day intake (in between 1.8 and 2.5 g/kg/day), an excess of 24% of the diet would need to be protein to support the fitness gains possible with CrossFit.

So where does this leave us? If we want to choose a named diet that best fits CrossFit, we would not choose Pritikin (low-fat), we would not choose Atkin's (low-carbohydrate). We need to have a diet that delivers a moderate quantity of every macronutrient – fat, carbohydrate, and protein – the basic physics and physiology of exercise adaptation demands it. We need less carbohydrate than conventionally thought but more than the low-carbohydrate diets. We need about the American Dietetic Association recommendation for fat content, 30% - not the exhorbitantly low quantities suggested by lots of low fat diets. And we need more protein than most clinicians are comfortable prescribing. Of

all the diets listed in the first paragraph, the Zone diet is the best fit. Although not an exact match, the metabolic and structural stress placed on the body by CrossFit training will be most closely or best accomodated by the 40% carbohydrate, 30% fat, and 30% protein recommendations of the Zone. I've only considered the gross energetic realities of diet here and have not really delved into the details of the Zone diet nor how the quality of food consumed as part of such a diet affects fitness. But is that really necessary? Information on the Zone is easily accessible in Dr. Sears' books and most people understand (and frequently ignore) that a high quality, minimally processed diet composition is always best. Mom told me that more years ago than I care to remember. Your Mom probably told you the same thing when you were a kid. Kathy Grunewald, PhD, LD, RD told me that as part of her graduate class in exercise and nutrition well over a decade ago. A school or hospital dietician probably told you the same thing as part of your education. Every CrossFit trainer should be saying the same thing. "High quality" does not mean simply buying the name brand of peanut butter, it means selecting foods that not only contain the macronutrients (carbohydrate, fat, and protein) we need but that are also naturally high in the micronutrients (vitamins and minerals) we need to support the CrossFit lifestyle. The approach taken to get that high quality can be widely varied, and is only limited by creativity and your cooking acumen – and that part is best left to someone else to teach besides me.

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