Exercise Physiology- Part 3

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So let's go to nutrient breakdown. Let's talk about proteins. Now, on the proteins, I'm going to come off this idea of metabolism a little bit because we don't use proteins that much for metabolism. It is used somewhat, but if you're talking about energy from macronutrients, we generally talk about carbohydrates and fats.

So energy from nutrient breakdown. I think we want to ask these questions. One is, do athletes need more protein? That's one of the questions we want to be able to answer. Does excess protein stimulate strength and development? Do supplemental protein powders work? And does excess protein intake have medical risks?

So as we go through protein, I want to keep this in mind, then we'll come back so we can answer all of these questions.

Just real quickly, metabolism and transport. Proteins must go through deamination before they are in a form that can enter the pathway for energy release. Now in terms of supplements for energy, here are the ones that you'll generally see written about. Leucine, isoleucine, valine, glutamine, and aspartate.

Now, these three up here are what we call branched chain amino acids and that's how you may see it sometimes advertised, the branch chain amino acids. And once again, there's some indication that these supplements might help. But certainly the research isn't enough to say, OK, we should be using this as a supplement.

I mean, creatinine monohydrate, yes, if someone used that as a supplement, I can say the research is pretty definitive that it's going to help. You can't make that claim with something like the branch chain amino acids. I will come back to glutamate, though. Once again, aspartate, I don't think the evidence is there enough. But we'll come back to glutamate in a little bit.

Now protein intake. This is, I would say, a big part. How much protein should you actually take? Now the RDA is about 0.8 grams per kilogram of body weight. All right? That's the RDA. I would think that most people would agree that that is not enough for athletes. But how much is a bit more of a question, a bit more debatable.

Now the other thing is most people equate protein intake with the strength athletes only and don't realize that endurance athletes, runners, have just as much, if not more, protein turnover and they might require the extra protein, also. That you can't just say, oh, it's just for strength, just for getting big.

No, in fact, the endurance athlete should probably have it, too. So if you look at some of the values I gave you, endurance athletes, the research indicates anywhere from 1.2 to 2.2 grams per kilogram of body weight.

Now strength athletes, and [INAUDIBLE] research really is quoted by a lot of people, where he came up with about 1.76 grams per kilogram of body weight. [INAUDIBLE], as high as 3.5 to 4.0 point grams.

OK. [INAUDIBLE], if I'm not mistaken, from Eastern Europe. He was working with weightlifters, Olympic weightlifters. So once again, you talking about a population I'm not sure we can extrapolate that to the normal population, trying to get 3.5 to four grams per kilogram of body weight in. Unless you're supplementing, you're probably not doing it. That would be very tough to do just on food alone. OK?

Is anyone from Nebraska? What would that be? A half a cow or something per day? Do we have any Nebraskans? But you don't know, OK.

OK, so that would be kind of for body weight. Those are two references. Now, [INAUDIBLE] has a book out on nutrition and it's really very good. Now he has some excellent research. I'm not sure you can accept all of his jumps. Sometimes he'll take the research, maybe jump a little bit. But I really think it's an excellent book, one you should look at, and he looked at, in terms of rehabilitation, where you would increase to two grams per kilogram of body weight depending on what type of injury they might have.

So you can see for soft tissue, he's recommending an increase for two to three months. But for the joints and the bones, he's talking about four to six months of extra supplementation through that rehabilitation process.

Now if we look at some of the proteins, when we talk about going-- you know, these supplements that might help with energy, the amino acids, there is no convincing evidence at all. When you talk about amino acids, no convincing evidence.

Now if you do supplement with the amino acids, though, you are going to create a positive protein balance. So if someone is working out, if someone is doing resistance training and that protein is available, it probably will be a benefit to them. But if they just take extra protein, is this all of a sudden going to be incorporated into the muscle? No, it won't.

There is also some indication that right after exercise, the protein is incorporated better. That if you take protein right after you do resistance training and two hours after, you can get a better result, you get a better incorporation, better assimilation of the protein. And some people are recommending a combination of protein and carbohydrates. There seems to be a window after a heavy resistance weight training program, heavy resistance, right after and within a two hour

period, that if you have a protein supplement or protein meal, you can incorporate it a little bit easier.

The one research that looked very convincing combined carbohydrate at 1.06 grams per kilogram of body weight with 0.41 grams of protein. Had it immediately after the workout, two hours after the workout, and one of the things they noticed is they had-- they're not sure if it was the protein, but they had an increase in plasma insulin, which means they were facilitating glucose across the cell membrane. And they also had an increase in growth hormone.

I've seen that in a couple of studies, that if you can supplement or if you can eat right after a heavy exercise program, or even endurance-- it seems whenever you do a workout, in endurance it might be glycogen and fluid replenishment. If you can do it rather quickly afterwards. The problem has been is if you are doing a heavy exercise, how many of you really feel like eating a big meal or drinking right after? But if you have a two hour window, you should be able to work it in, athletes should be able to work it in.

There seems to be some pretty good results with that. It's also known as beta-hydroxy-beta-methylbutyric as a supplement, and this is a leucine intermediate. Remember I spoke to you about one of the branch chain amino acids before, leucine?

And it's not so much that it incorporates, it seems to inhibit protein breakdown. More than anything else, it seems to inhibit the protein breakdown as opposed to facilitate a greater incorporation.

And then the glutamate, which I want to come back to also. Glutamate is interesting because where you tend to see, when I looked at a lot of the research, apparently, where they've had great results with glutamate supplementation have been in patients in severe stress, not necessarily athletes.

If you look at some of the research-- patients undergoing open-heart surgery, patients in burn units. Apparently, under severe stress glutamine is used extensively. And there seems to be a deficiency. And when they supplemented the glutamine-- now, once again, it might be that you need to supplement more than just glutamine. But glutamine supplementation seemed to really have a tremendous effect on patients who were in severe distress.

And I don't know if you can extrapolate that to an athlete. Although some of the athletes, as hard as they work, you could make a case that is a severe stress. I still don't know if you can match it up to someone undergoing heart surgery, but that's where you see some of the effects of the glutamine, some of the research in there.

So if we go back to our original questions-- do athletes need more protein? Yes. I think they do need more protein. I think the RDA is probably too low. And we know that, often, pregnant women are advised to take at least 20 grams a day extra. Why? Because of the growth of the baby.

All right? So we know that for growth, you do need the extra supplementation. There's no way 0.8 grams per kilogram of body weight is going to be enough.

And if you take that under the same line of reasoning, kids-- you know, 13, 14, 15-- they're growing too. They could probably use some of the extra protein also.

If someone is on anabolic steroids-- I'll get to that in a very short period of time. Anabolic steroids and one of the effects it has and what it does. OK? It's a very good question in terms of growth and how it helps incorporate more protein into the muscle.

Does excess protein stimulate strength and development? No. However, it helps. If they're doing strength and development, the protein will be very good for maintaining a positive protein balance. But just the protein by itself will not work. That's almost like anabolic steroids. If you take anabolic steroids by itself, it's not going to create a bigger person. You still have to create a need for it. You have to still provide the training regimen.

Do supplemental protein powders work? Yes. They do seem to work. But if you break it down, cost per ounce, they tend to be very expensive. And you could probably get some very good protein intake with fresh fish and some fresh meat as opposed to the protein powders.

Now, we'll often see kids taking protein shakes or creating their own protein shakes as a filler, which is a good idea. But here's the problem when they do something like that. When they create these protein shakes, they'll often-- you know, they'll down the entire container. OK? Sometimes, that fills them up and they end up losing a meal. So a protein shake or a supplement, somehow between meals, so that you don't lose the meal, will help them and help them gain weight.

You know, we always talk about weight loss. We don't realize that for a lot of the athletes we deal with, especially on the high school level, especially the boys, it's about gaining weight. It's a true problem.

I have athletes-- I have a 16-year-old son who's just going crazy trying to gain weight. He's doing some weight training. And he has a goal. But I just-- you know, I have to explain to him sometimes, you may not gain weight. At a certain point, you will. Then later in life, you'll gain more than you want. You know? And there's a certain timing to this.

But it's a very real problem for some of these high school athletes, especially taking into account that if you look at the varsity level of the high school, you may have a sophomore competing with a senior. And that could be a significant difference in size and weight. OK? And also they don't develop as quickly. So once again, that could be a problem.

So if they're going to do the protein-- I have seen extreme cases where, to get the extra meal in, athletes will wake up 4:30 in the morning to eat, and then go back to sleep. And then wake up

about 7:00. That's where they get an extra meal in without taking away anything during the day. Or sometimes the protein bar snacks beforehand.

But when you talk about the athletes and how much they work-- you know, at one point, when I ran track in college, I was keeping track of my calorie intake. You know, I was eating 4,000 or 5,000 calories a day, and I couldn't keep weight on. That's what happens when you run 70, 90 miles a week. A high-level athlete there. How many calories do you think you were burning when you were doing the kayaking? 4,000 to 6,000.

4,000 to 6,000 a day with the kayaking. She was an elite kayaker for Canada. OK? And the amount of calories-- I mean, that's why if you've ever read any of the classic stories about Bill Rogers who ran the Boston Marathon, what did he have for breakfast? Leftover pepperoni pizza and Oreos.

If you're burning it right away, you can do that. When I tell you that sometimes I, for breakfast, would have a quart or a half gallon of milk and a full box of Entenmann chocolate donuts. That would be my breakfast. You know what kind of calories and fats that are? I'm probably paying for it now. I mean, I may keel over at any point. That's a lot of saturated fat to put in your body. I'm sure it's taking its effect.

We'll talk about exactly how clogged my arteries might be without me knowing it. That'll come under the-- when we talk about cardiac physiology. OK? So you can get away with some of those things.

And let's go to the last one. Does excess protein intake have medical risks? We really haven't seen this. Are there risks? Yes. The risks are possible. You know, when you talk about metabolizing and breaking it down, and possible kidney problems from the deamination, the constant dissemination, because we really can't use the protein it gets in our body. The first thing is it usually gets deaminated. So is it possible? Yes. Do we see much of that? No.

Water. I don't think enough people realize how vital water is. When we talk about-- if someone asked me, well, what's the number one supplement I should take in my diet? I would say, are you getting enough water? OK? Or in New York, as we say, (WITH ACCENT) water. If you don't have enough water, it's just-- things aren't going to work.

And we look-- even with all the supplementation you do, one of the things we notice is, a cell that's dehydrated will not incorporate anything into its metabolism or its chemical pathways. A cell must be hydrated properly to incorporate any of these other supplements.

Now, if you look, dehydration occurs at 2% loss of body mass. In muscle wasting diseases, cellular protein turnover and muscle protein synthesis vary according to the water content of the cell. OK? So that is probably the number one thing we have to look at. OK?

Now, in your notes, you can see where we lose some of this. 12 ounces a day breathing. 24 ounces a day through the skin. Two quarts per hour during strenuous exercise. How much do you need?

Now, when you look at this, these are all different recommendations that I've seen. The one I like the best-- one milliliter for every calorie that you expend. One milliliter for every calorie that you expend. Typically, most men in this country are going to probably expend about 2,700 to 2,900, which means you've got to get in almost three liters of water per day.

And it doesn't just have to be water. It can be in juices. You have water in the food you eat. All right? But you going to need close to three liters. And it would be interesting-- how many men do you think are getting that much? It's probably a deficiency. Excuse me.

It's probably a deficiency that we have. OK? And when you take into account-- those same people who aren't getting enough water, how much of them are drinking coffee or diuretics? Or how many might be drinking the dreaded beer? OK? Who are coming in-- so not only don't they have enough water, then they have maybe two or three beers.

Now, we're not discussing the advantages of beer as a supplement right now. I'm not bad-mouthing beer. Don't get me wrong. Just saying that everything has risks and benefits. So some of the medicinal benefits of beer might be outweighed by the fact that it is acting as a diuretic for water in the body. OK?

So for women, who probably average about 2,200 calories per day, typically-- this is not an active woman. This is not someone who's doing an exercise program. A little over two liters of water. So I think that, probably, we have a deficiency of water more than anything else.

Now, if you take into account someone who exercises-- a good workout you could easily burn. If you're working out for an hour, it would be very easy to burn at least another 1,000 calories, which means another liter of water to help make up for that.

Now let's look at some of the metabolic relationships that we have. Now if we look at the system-- adenosine triphosphate phosphocreatine system. OK? The substrate is stored phosphagens. So now we're just reviewing the system and what the substrate is that is required for the energy. So the ATP and phosphocreatine, it is stored phosphagens that work. For glycolysis, it's the breakdown of glycogen and glucose. Remember, glycolysis can be aerobic. It can be anaerobic. Then after that, we move into aerobic metabolism. And now you're using glycogen and glucose, but you're also using fats and you're using proteins. But the proteins are going to be negligible. So that's how we use these systems.

We'll go into this in a little more detail, But I just wanted you to get some idea of what's going on here in terms of time. That when you're sitting here right now, you're using all three systems. None of these systems ever shut off. OK?

So you can see right now, if you were to do an intense exercise for a couple of seconds, you can see the primary system would be the splitting of the ATPs, the high-energy phosphates. As you increase your time, you start getting into more glycolysis, anaerobic. And as you keep working, in here, you see that the aerobic metabolism picks up. So aerobic metabolism picks up, the anaerobic glycolysis, that starts to swing down.

So whenever you're doing an exercise at any point, you're talking about a combination of all the systems. All right? Right now, using high-energy phosphate. But you're replenishing them very quickly.