

Exercise Physiology- Part 9

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A little bit about muscular strength, muscular endurance, flexibility-- I want to get a little bit more into the strength conditioning. Now if we're talking about testing muscle strength-- and we'll spend probably a majority of the time on muscle strength. Some of the different ways you're going to test this-- when we talk about strength, some of the different possibilities-- tensiometry, which is a fancy way of saying the cables, the equipment where you press it, where you're pulling against a cable.

Dynamometry, which is more of a compression device. You've all seen the hand dynamometers, so it's more of a compression device. One repetition max. And also, you will see computer assisted, some of the Cybex machinery. So these are some of the different forms that you can use in testing.


The one rep max I bring up, a lot of people say, well, the risk is high. Someone. Can get Very rarely do people get hurt doing one repetition maximum. OK? And the reason why is because most people are aware of how hard it is. And they really prepare, and they get ready, and you have a spotter.

So generally, people who weight train do not get hurt with one rep max, unless you're talking about in certain competitions where they're approaching weight that they've never done before, they're trying to break records. But generally, people will not get hurt and one rep max. Where would they have more of a tendency to get hurt?

Five or six rep max, when they start doing that. Why? Because they start fatiguing out, and they try and get that last one. So they're more likely to get hurt on a five or six rep max than they are on a one rep max, even though some people do that type of testing. When your weight trained, for those of you or if you've ever worked with athletes who are doing Olympic-type lifts, either the snatch or the clean and jerk, they usually run into trouble.

Because it's such a technique-driven type of exercise, and there's such a high risk for damage or for injury. You don't really want to do with a heavy weight, more than two or three repetitions. You can't afford to fail to fatigue in there. I mean, they do have ways of dropping the weight, experienced lifters. But you have to be very careful with your football players in your basketball players who aren't familiar with the technique.

The Olympic lifters know what they do. It's when you have other sports using these lifts, that really haven't been supervised properly or do not know the technique properly, that tend to get hurt when they do this type of thing. So if we look at muscular strength in there, you also want to look in terms of gender differences when we talk about strength. And what are the gender differences?



OK. Now keep in mind if you're looking at the cross-sectional area of the muscle, if you teased out everything else in percent body fat and just look at the cross-sectional area of muscle of a female versus a male muscle, there's no difference. It is equal. Now if we look at the actual structure, though, the difference comes in is that women generally have less muscle mass in the upper body.

Lower body, they do pretty well. When they look at tests and look at differences in strength, male versus female, upper reversal lower body, the big change is in upper body. In lower body, women test out very well. And if you kind of extrapolate and take out the essential body fat that they have, you'll find that a lot of times it's equal, that there is no difference.

So if you are testing male or female, what would you do then to eliminate some of these gender differences? If you want to do kind of equal testing between male and female, how are you going to tease out some of these differences? You have to use an exercise then that focuses more on lower body strength if you want an equal test.


Let's say you just want one or two tests and you want to get equal values, and you want to do something that also eliminates the upper body. For example, if you were testing the legs but you decide to test legs with a clean movement. We also want to talk about muscle actions when we talk about strength testing. And what are the muscle actions? Concentric, eccentric, and isometric.

Concentric, developing tension while the muscle shortens. Eccentric, developing tension while the muscle lengthens. Isometric, developing tension with no movement at all. So technically, if you're doing isometric contractions, you're doing no work. Of course, work is force times distance, and there is no distance moving. So from a technical standpoint, you're not doing any work.

Now when we talk about isometrics having no movement, is that actually true? It's true in terms of global motion. So if you look at the bicep-- if I do an isometric contraction here, no. The elbow is not technically moving. But if I tighten up, you will get some movement in the joint. You'll get compression. You can get shearing forces.

So an isometric action can still hurt, if you're irritating that part of the joint that's hurt. You also have isokinetic. Isokinetic is working at a fixed speed. You see sometimes the Cybex machines, where you have a system where it pushes back as hard as you push. Now when we look at isokinetic for a second, the reason why the isokinetic becomes important if you're looking at the research, is because a lot of the research on fast and slow training is based on isokinetic training, isokinetic training, fixed speed.

Now with a lot of the isokinetic training, when they talk about slow speed and fast speed, how fast should you work, they talk about, OK, fast speed might be 60 degrees per second of torque, where-- that's the slow speed, I'm sorry, where fast might be 300 degrees. OK? So you'll



sometimes see research that says, you know what? When we did this type of training, fast speed, working at a faster speed they got greater strength training.

Now if we look at real live time-- let's look at the knee now for a second. On a vertical jump, the speed of the knee in a vertical jump in real time is about 4,000 degrees per second. So if you can see when we talk about real time what we're doing versus what fast speed is on the machine, you can see it doesn't seem to be a great correlation. So you have to be careful with fast and slow.

Now should you be training at fast speed? Well, we know, yeah, if you wanted to develop power you have to train at a fast speed. Strength, if you're just talking about pure strength, you can train at a slower speed. But if you're talking about power, which is a function of time, you have to train at a faster speed. You have to do these explosive movements. There's no getting around that.


To give you an idea of a shoulder, when you bring a shoulder around-- anybody know if you're throwing a pitch, how fast your shoulder comes around? Measurement is from 5,000 to 7,000 degrees per second. That's how fast, from a high school to professional pitch can be, 5,000 to 7,000 degrees. That is very quick. We don't have any way of testing that. All right?

Now they have done some machines. I remember at one point in college where they had us training on something called the Bear. I don't have to write that down. And the Bear was like a sledge, like for squatting, where you would get in. They had shoulder pads, almost like a squat. And you would push up as hard as you could, and then you'd come down.

There'd be no resistance. And you'd push up, and come down, and, push up and come down. And you'd get a lot stronger. But they found there seemed to be no correlation. We didn't seem to be getting any increases with vertical jump. So we'd be increasing our strength, per se, but we wouldn't be increasing any of our power explosion for the sport itself. And that's why you don't see these machines in the gym anymore. Where you may see them as in rehab facility, Cybex, if you're rehabbing a knee and you're doing extension and curl.

Why? Because if you're rehabbing an injured area as you keep reading happening if you start to get a little tired you won't push as hard and the machine will also back off, so you're not as likely to get an injury. The converse of that is to someone who's not motivated, they could go very easy and still had that same speed without working that hard. OK? So that's what we see in terms of isokinetic machinery.

Now when we talk about muscular strength, most of this is resistance training. That's what we're talking about, resistance training. So which are better? If you're having someone train, is it better to have them train with free weights or machines? By a show of hands, if you like free weights better, raise your hand. And if you like machines better, raise your hand.



OK. So we have a majority of free weight. Now which is better from an expert's opinion? And since we don't have an expert, I'll give my opinion. It depends on what you want, that there is no - here is the advantage of free weight, that you end up using balance. You get the proprioceptors involved.

It seems to have a little bit more correlation to sports exercise. But one, you need a spotter. Two, it's not always available. There's a danger with using it, OK, versus machines. You don't need a spotter. Granted, maybe you're not balancing, but you still have strength. Does a muscle know whether the resistance is from a machine or from a free weight or anything else or from pushing a car?

Why do squats or sleds? Why not just get behind a car, put it in neutral, and push it? And I bring that up, is because that's what we had to do. [LAUGHS] OK? All right? Keep in mind for a second, we used to do sprints. And I think it was Dick Butkus who used to do it, also. What you do is you do 10 sprints.

If you have ever had to push a car out of the snow, for example, didn't it feel like a great workout? Because you have to get really low. You have to drive. For the rugby players well getting in the scrum, it's that same position. You're getting down low and pushing out, for a football player. So it's a great exercise.


So if you do a sprint for about 10, 15 yards and relax, it becomes a great interval workout. You don't necessarily need machinery. I mean, there was a time where they didn't have machinery. People used to-- OK, this is going to date me a little bit. People used to make their own weights.

They would get two buckets. They would put concrete in one, put an iron pole, let it set, and then flip it over the next day. And that would be the weight set in there or just using general weights. There is a strength and conditioning coach, he's retired now from-- he coached Apple Valley for years. I don't know if you're familiar with Bud Bjornaraa. But Bjornaraa, probably he's one of those guys who's forgotten more than most people know.

Tremendous strength. And he developed his strength where? On a farm. He had no weights or anything. Apparently, his dad and uncles were very competitive. And they used to do tests of strength. They used to do all these competitions. And he learned to do pull ups in the barn with a pinch grip, where he would hang onto the beams like this.

This is how he did his pull ups, pinching onto a beam. That's how he did it. He actually played football at the University of Minnesota. And now this was before they were allowed to use weights. No one used weights. But Bud had a system. He was using weight training, and his roommate would use it, too.

So he had a group of four or five guys who were using weight training. And the coaches started noticing that there were a group of four or five guys who were so much quicker and stronger than



everyone else. Remember, at this time when you talk about '50s and the '60s, weight training was not considered a good thing for athletes. Why? Because it made them inflexible. They were bound up.

And the coaches noticed this. And they said something. And it came out, and then they started saying, well, maybe you get some of the other guys on this, too. So Bud actually got the university to start using weight training for the football team at the time. I don't know who the coach was at that point. Bud took a lot of his ideas to Apple Valley High School, and for years apple Valley High School just dominated the entire region.

And a lot of it had to do with the fact that they were doing weight training and conditioning that Bud had set up. Bud had set up for the 1980 Olympic team, the hockey team. It was Bud's land training that they were using. Not their skating, but Brooks was using his land training scheme. So you really can do a lot.

There's a tremendous history behind it. So we're generally using resistance training. Once again, the body just knows whether it's working. It doesn't know how it's working. What's one of the latest trends in weight training? I even saw a poster up for it at the school. Kettleballs. Have you seen the Russian kettleball training? It's looks almost like a tea kettle with a bar, and they have different weights.


And they're doing all kinds of training with it. How new is it? If you go back 150 years, you look at some of the pioneers of training, Eugene Sandow and people like that, what will you see? You'll see pictures of them using these weights and these kettleballs. All right?

So people stopped using it. Now it's being used again. Why? Because as a weight, I mean, you can do tons of things. They do all kinds of balancing with it. Once again, it's a free weight. They use all kinds of balance with it. And I have found, because I went to one of these conferences on kettleball, for the military it's a tremendous exercise that they're using. Why?

Because first of all, it's easy to transport. They put it on a truck, it doesn't take up a lot of space. And I found that they're using it on ships and submarines because the kettleball, you can put a pole through the middle and you can secure them on the boat so they don't move around. So you put an iron pole right through all the kettleballs.

You can have an entire set of kettleballs secured whenever you need to. Pull the bar out and they have a tremendous weight training facility that they can have. So you can see there are a lot of different ways of doing it. The proverbial cat can be skinned in a number of different ways. Now with resistance training, I think we want to bring up this concept of periodization.

I'm going to tell you of the Russian who really brought a lot of this. M-A-T-A-Y-E-E-V, I think that's correct, really brought a big thing to the concept, is that an athlete cannot work at the same



intensity all the time. They need recovery. They need to cycle. So he talks about periodization, we pick a period of time so that you can peak, the whole concept of peaking. All right?

Now the cycle would then be the macrocycle. So when you're helping an athlete, what would the macrocycle be? It depends on the athlete. For an Olympic athlete, the macrocycle is four years. If you're helping a high school athlete, the macrocycle might be one year, from one football season to another. So that's the macrocycle.

Now in that macrocycle, whatever it might be, you break it up into mesocycles. So do you have a sport you want to deal with? Anybody throw out a sport, a high school sport.

Wrestling.

Wrestling? [LAUGHS] Wrestling? OK. Let's look at wrestling, then. So wrestling, would you say it's fair to say that a macrocycle would be one year to the next? OK. So we have a one year cycle. Now what you want to do is you want to divide up your mesocycles into competitive season. Then after the competitive season, post-season, off season, pre-season.


So that's probably how you would divide your mesocycles up. OK? So we look and look, and you can start wherever you want. If you want to start, we can start in pre-season, competitive season, post-season, and we can go off season. And you can really-- if you design this, you can divide up any way you see fit.

So if we're taking a high school junior now and we want to prepare him for his junior year and get him ready for his senior year, what do you want him to do in the pre-season? OK? Pre-season, as a wrestling coach, what are going to be your primary goals, pre-season? So if you look at pre-season, would it be fair to say pre-season is not a time that you're looking at necessarily increasing strength?

You just want to make sure they maintain what they have, and they practice their skills. So their weight training at that point, then, you're not looking-- they're not going to be weight training for strength three or four times a week. They may just be straight training twice a week to maintain their strength at this point. They won't be doing maximal lifts, plus they'll be working so hard during their practices they'll get a lot of it there.

So you're looking at maintaining strength, maintaining flexibility. So they might only be in the weight room twice a week to maintain strength. And they won't necessarily be doing max lifts. And you're probably getting them in and out quickly. You're probably looking at like, minimum sets assert eight reps, but maintaining strength.

Now you get into the competitive season. Goals during the competitive season, once again still maintaining strength and flexibility, also taking care of any injuries they might be occurring. So



this might be even more rehab. So you can see how competitive season, they still are going to be kind of calm on the weight training.

You might have them do, for wrestlers, maybe a little more pool work, once or twice a week in the pool which may help maintain flexibility and recuperative powers. OK? But a lot of times-- and would I be correct-- I don't know a lot about wrestling. I'm not a big wrestler. But don't the athletes constantly go through wrestle-offs to find out who's going to be wrestling, also?

So maybe they're competing on Saturday. But when would a wrestle-off take place? So maybe a Wednesday, so they have enough time to recuperate. So if they're wrestling competitively Wednesday and Saturday, look at the rest of the days. Sunday is kind of being a recovery day.

Monday, you could possibly do some easy weight training. But they're not going to want to weight train Tuesday before the wrestle-off or Wednesday. So your days of actual wrestling, when you're setting up this mesocycle for the wrestlers is they might do a weight training on Monday and maybe Thursday, light on Thursday after the wrestle-off. OK?

But this way, the days before the wrestle-off and the competition-- you can see how you set up your cycle. Now post-season, what are the goals in post-season, usually? Recovery. Recovery. And a lot of times when we talk about recovery for athletes during periodization, we like to use the term active recovery, which means they don't just stop doing everything. You want them to stay active, but generally stay active maybe with a different activity, something they like to do.

So for the wrestlers, it might be instead of wrestling maybe a couple of weeks, maybe they're doing some swimming. Maybe they're doing some snowboarding. You know, stay active. Well, maybe the coaches don't want them to do snowboarding. [LAUGHS] But stay active, maybe not doing a lot of weights, some weights in there.

And then you get to the off season. So the post-season might only last two to three weeks, maybe a month for recovery. Now when does wrestling generally end, Minnesota State High School? Does it end early March? OK. So it ends early March. So figure April is when the off season might start for your athletes. And when does the season start?

September. So pre-season is August, about? When are the first competitive meets in wrestling?

November.

In November. So the competitive season starts November. So the pre-season for the high school wrestlers are probably September, which means they have probably April to August to address their weaknesses. So for them, for wrestlers in Minnesota High School, probably their peak weight training will be from April to August. So if you're training them, let's say they haven't had a lot of weight training, April will be a lot of development, a lot of three or four sets of 10 to 12 reps, a lot of development through April.

And then maybe through May, you end up dropping the reps down to maybe six to eight reps, increasing the weight a little bit, getting a little bit more of a combination of strength and endurance. OK? June, you then might do your power movements. Now that would really go for increasing the strength. A lot of power movements, two to three reps, high weights through June.

Back off a little bit in July, and go back to your combination of maybe developing a little more endurance. And then in August, go through another power stage, and that brings them into their pre-season training. So you can see that's how you would do a periodization for a high school wrestler. Question?

What do you do with athletes that are in three sports? What do you do with athletes that are three sports? You praise them. OK? And here's the problem. That is actually not as big a problem, three sports. Because they're using, usually, different muscles. Even if the sports are somewhat similar, they're using different muscles. I'll bring up the problem instead of three sport athletes, one sport athletes who don't stop the whole year. OK?

To give you an example, for soccer, because that's what I'm most familiar with. High school soccer player-- they report to captain's practices in early August. Right? In Minnesota, they actually start their games late August. Their competitive season starts before they attend class. All right?

If they're lucky to States, they will go to early November. If they make States. Now most of these players are playing traveling soccer in the summer. Do you know when-- so let's just look at this for a second, just to give you an idea of how you might do periodization. OK?

High school soccer, so pre-season is August. Just to make it easy, competition will be from September through November. All right? After November, many of them then play indoor. The indoor leagues start late November. So indoor now, late November.

Indoor seasons, they usually have two or three competitive seasons. They go until March. OK? Late November to March. Traveling soccer usually begins in April. April, and it goes into the end of July, beginning of August. And then they report to captain's practices. OK?

Now for this travel team, the travel teams for this summer, when are the tryouts? Do you know when they try out? They usually try out the end of July, beginning of August here. Why? Because they can't try out once the high school season starts.

So if they don't do tryouts before the high school season starts in July and August, they have to wait until the middle of November. And the teams don't want to wait until then. So if you look at my son, who's playing for more of an elite type soccer team, his schedule-- if we look at training, he competed until August. OK? He had his tryout. He went to captain's practices in here, September, November. His traveling team started practices in November. He actually had some scrimmages in November and December. His first match is March in Virginia, March 17 we go down to Virginia. That's when his first matches are. He will compete traveling high level until the end of July, beginning of August, where they may do one last tournament in San Diego.

So he'll come back from his tournament in San Diego to start captain's practices. There is no cycle. Well, I change it. It's a never ending cycle.