# Exercise Physiology- Part 8

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So if we look at physical fitness testing, we want to come up with some sort of screening, you can see under the pre-participation health screening, once again, specifically, what are you doing here? You're trying to identify and exclude individuals with medical contraindications to exercise. And we'll go over some more specifics on that when we talk about the PAR-Q. You're trying to identify persons with clinically significant disease conditions who should be referred to medically-supervised exercise programs.

Often, one of the problems is, for a while, I was directing at what we called a phase 3 cardiac rehab program, where phase 3 is its outpatient with medical supervision. And what that would entail is people who are very high risk or who had bypass surgery, or had had coronary MIs before, they would be evaluated. They would be sent to my program. And three times a week, they would exercise under supervised conditions. Twice a week, I was the actual instructor.

And when you're talking about these problems, what supervision entails is, first of all, I would have a crash cart there-- not that I would ever actually use it. But it would be there if I had to call medical emergency or medical help. So I had a crash cart there.

Also, everyone had a sheet. And what we did is we did intervals of five minutes. So every five minutes, they would check their heart rate. They all had specific target zones-- we talked about specific target zones-- based on a stress test while they were on their medication. This is what I mean. If we had taken some of these people based on their age to heart rates of 120 or 130, I'm sure that would have been the end for them.

So often, we would get heart patients. And their target zone might be 90 to 96 if they were trying to get their heart-- if they were on beta-blockers, their heart rate might be 60 or 66. So they weren't going to go much higher. One of the things that we often found is it's not just heart rate, but every once in a while, we would do blood pressure. Sometimes, blood pressure is a better indicator if they're having any problem in heart rate.

We would also do telemetry. Every so often, a pace would be scheduled for telemetry, where I would hook up electrodes. I would have a telemetry unit that I would transmit over the phone to the hospital so they could do, actually, EKG. The big advantage to something like this is a lot of patients want to get back to what they were doing beforehand. Maybe they play tennis. Maybe they wanted to shoot some baskets, things like that.

What we would actually do is they would come in maybe early for a half hour. We would actually set up a tennis net. We'd have someone playing. And this way, they would have a chance of exercising with the telemetry unit so we could find out exactly what they could do. For

example, in some tennis players, what we found is singles was too strenuous, but doubles was fine.

Also, we would put them in the weight room because some of them wanted to do weight training. This is one of things about cardio patients in general. They were always given, always, cardiovascular exercise, and the weight training was excluded. Why? They were worried about blood pressure. We would actually put them in the weight room, and we would check. We would do blood pressures while they were lifting.

So we could come up, if they were doing some maximal lifting, it's not a problem. Weight training was very acceptable for most of the cardiac patients. If you did a bench press, for example-- just to give you an idea of what kind of blood pressures you reach during normal exercise, not during the power-lifting I was talking about yesterday, where guys are putting 800 pounds on their shoulders-- but in general, a bench press. Let's say you do six to eight reps of a bench press. Do you know what your blood pressure goes up to generally, with something like that? Maybe about 250/160 for a short period of time.

That might be too much for a cardiac patient for that period of 30 to 40 seconds. But if you brought them onto a machine, which generally is a lower blood pressure-- you're working at a lower blood pressure and did sub-maximal lifting for 8 to 10 repetitions, you can help prepare them. And you have to do this, unless you're telling them not to go lift, not to go shopping, not to do anything during the rest of the day. You have to somehow prepare them. So the weight training can be used.

Number 3, to identify individuals with disease symptoms and risk factors for disease development who should receive further medical evaluation before starting the exercise program. So these are pretty much all going along the same lines. Number 4, to identify persons with special needs for safe exercise participation. How are we going to do this now, number 5?

First of all, self-administered health questionnaires can be very helpful, give you an idea of family history, what they can do, what they have trouble with. The physical examination-- and generally, I do not do a physical examination all for cardiac evaluation. That's something I always refer out to. Analysis of the coronary artery disease risk profile, which we discussed-- diagnostic exercise testing, which would be, once again, the stress test. And then, if you have to, advanced cardiac diagnostic tests, possibly invasive tests-- catheterization, things like that.

Now if you look here, the age is apparently healthy men over the age of 40, and apparently healthy women over the age of 50 do not necessarily require medical examination testing if they they're going to begin an exercise program with moderate intensity. Those values have actually changed to 45 and 55.

And finally, what a lot of people have been using, which came out of Canada-- that was developed in Canada-- is what we call the PAR-Q, the physical activity readiness questionnaire. And if we look at that, now this is easy. If you wanted to use something like this, you can definitely use it. One of the things you'll notice is they want you to download this. If you could just go on your search vehicle and punch in PAR-Q, if you look right down here, no change is permitted. You are encouraged to photocopy the PAR-Q, but only if you use the entire form.

In other words, they want to make sure you use it properly. They are saying to you, if you use it properly, please, by all means, go ahead. This is very good. I know some of the trainers in gyms are using this as part of their waivers and release forms to make sure this is done.

Now let's just look at this. And these are the seven questions they're asking. 1-- has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor? If that is a yes, then they probably should not start an exercise program unless they've been evaluated. Chances are, if their doctor has said that to them, they probably have been evaluated. You know, it's not the question, you know what? I think if you want to exercise, you should have an evaluation. But you can just leave for the day. Generally, they are going to be evaluated.

Number 2-- do you feel pain in your chest when you do physical activity? Could it be indigestion? Absolutely. Should they be evaluated? Absolutely. Number 3-- in the past month, have you had chest pain when you are not doing physical activity? Unless, of course, you were at a Mexican restaurant and had the blazing food. That would be an indication that may not pertain to this.

Do you lose your balance because of dizziness, or do you ever lose consciousness? This is the syncope we talked about. They're having trouble if they can't explain it. Number 5-- do you have a bone or joint problem-- for example, back, knee, or hip-- that could be made worse by a change in your physical activity. Now that's one of the questions that they answer yes to, I don't necessarily send them for medical evaluation. In my mind, I'm probably going to be just as good for doing that evaluation as any medical doctor. In fact, I find medical doctors may do a very good job of the evaluation, but often don't know what to do in terms of exercise or how to handle a lot of the joint problems.

Number 6-- is your doctor currently prescribing drugs-- for example, water pills for your blood pressure or heart condition? So any of these questions that answer yes, they should have a medical evaluation before they start the exercise. Do you know of any other reason why you should not do physical activity?

And that's interesting. Sometimes they'll say, because I'm too lazy. I just don't feel like I should. So in that case, if they really-- sometimes, you can get some sort of information from that. They may answer no to some of these questions. But when you ask them this question, maybe an episode may pop out in their mind. Now that you think of it, I was shoveling some snow and boy, I felt really tight-- more than usual. You may get that kind of response, whereas they didn't respond to the fact that maybe they had chest pain. So this is an example of sending for a medical evaluation. And if they answer yes to any one of those questions, they should be sent for a medical evaluation-- not necessarily will they get their exercise program from the medical doctor, though.

Now this second page of the PAR-Q gives you a little bit more specifics-- the absolute contraindications, relative contraindications, special prescriptive conditions. So you can see some of the absolute contraindications in here-- aortic aneurysms, aortic stenosis, congestive heart failure, which probably doesn't fit in as well. Because exercise is actually a form of therapy for congestive heart failure, but it is very specific. You've got to be very careful with it.

Myocardial infarction, acute. Once again, if they're having a myocardial infarction, it probably would not be a good idea to go out for a three mile run. Just a heads up for you. Thrombophlebitis we have to be very careful with. And we will sometimes see that in our office. Ventricular tachycardia is another problem in there. And then any acute infectious disease, at that point, you have to be careful with exercise. That's something you want to start.

Now I'm going to bring you down here. Pregnancy, if you look, relative contraindications not absolute. But relative contraindications on pregnancy is if they're having any kind of complications, hemorrhaging, toxemia, and then under special prescriptive conditions, the advanced pregnancy-- third trimester, maybe gestational diabetes, in some cases, you'd have to worry about that.

They do have a special form part of that X for pregnancy, that pregnant women can use to see if they should be exercising or not. This is an excellent tool, the PAR-Q. It's also a tool you should be aware of. A lot of times in your practice, now you're all doing the program because you want to get the specialty training. But sometimes it's just as important to know, well, I'm not the expert in it. Who is the expert in it?

If you value exercise for your patients, it's not easy to do it in your office. It can be very tough. You should at least know everyone in your community who can do it. If you have a 72-year-old patient who needs maybe to do swimming, but they need a little bit of a heated pool, what do you have in your community? Where can you send them?

If you have a 36-year-old woman who's taking care of three kids at home, where can they go? Which facilities may have daycare that they can actually bring the kids and have the kids taking up so they can do their exercise program? So I often feel that your expertise almost involves knowing what facilities, what kind of instructors, who you have around you in your community as much as you being able to do it yourself.

Let's talk about some of the physical fitness testing. Now we're getting into cardiorespiratory endurance. And once again, I mentioned the sub-maximal ergometer test to you, an estimate of VO2 max derived from the heart rate based on the linear relationship between heart rate and oxygen consumption. Maximum heart rate and VO2 max tend to be achieved at similar levels of output. Remember that linear relationship. That's very important.

Some of the tests may not be as reliable as they are represented. One protocol suggested by the American College of Sports Medicine significantly overestimated the VO2 max in 85% of the cases in one study. So we want to be careful not to rely on this when you need a very accurate assessment. Once again, that would go back to people with certain medical risk factors. For a general assessment, that still appears to be a very useful tool.

Sub-maximal tests, they're on an ergometer. You can do them and it's easy to do. It doesn't take a lot of space. Once again, I still think it's something best done in the gyms. A lot of the Ys can do this type of testing. Now, the step test-- and this specifically is the Queen's College step test that we'll talk about-- and you can do the modified step test. The run/walk test that we often see, the Cooper 1 and 1/2 mile run, how quickly can you do it.

But the Queen's College step test-- and I gave you the specific notes on this-- students complete a three minute session of step-ups. And these step-ups are 16 and 1/4 inches high. Anyone have any idea why it's so detailed? I will tell you why, because if you pull bleachers out of a stand in most facilities, the bleachers are 16 a 1/4 inches high at the steps, that's why. Because this is an excellent test that's often used to test multiple people. Testing 30 to 40 people at one time is not tough with this step test.

So could you do it in your office for one person? Yes. But if you're working with community groups, you can do a basic exercise class for people in a community group in a school gym and just pull out the step. And people would just go up and down on the step for three minutes. Now you can see, there is a slight difference. Women are 22 step-ups per minute-- which would be if you had a metronome, that would be 88 beats per minute. Males, 24, and that would be 96 beats per minute.

In general, the reason they have them do is because at 16 and 1/4, it's generally a little bit tougher for women than men. The only reason being is the general height difference. For women in a lot of cases, that might be a tougher task. So you would do it a little bit slower. So that's the reason for the difference in there.

Then after you do it, you then measure pulse rate. Now, when they start, you do it for three minutes. And then when you're done, you measure your pulse rate. You take your pulse. So as soon as you stop, you take your pulse. You don't begin counting till five seconds in. And you count from 5 to 20. That'll give you a 15 second reading. And then you multiply by 4.

The reason being is this is not tough for a lot of people. If you do the full minute, the heart rate will slow down and you don't really get as good of an idea of what the recovery heart rate was immediately. And now this is a chart. You may have seen this in gyms before where they have the chart where you point to how hard you're working, rating of perceived exertion. And this is Borg's rating of perceived exertion-- the Borg RP. And you can find this in a number of places-- textbooks. You may have seen this in gymnasiums before, I think I've seen it in swimming pools, actually, more than I've seen in gymnasiums where they have them. You can kind of point to what's going on in here. And if you look, a person will actually point to a number. You can have them exercise and they'll point to a number and tell you where they feel, what they feel like they're doing-- so from no exertion at all, to light, to somewhat hard in here.

Now his scale actually relates-- and you think, well, why a 6 to 20 scale? And there is what they call the modified Borg, which is a 0 to 10 scale, which is actually the one that doesn't make sense. This is really almost based on heart rate. If you multiply by 10, you'll come up within a heart rate which is pretty similar to what they would be if they were working out hard. So at 13, which is somewhat hard, their heart rate is probably going to be about 130 when they do it.

And they've come up with some very reliable ratings on this. And I just want to show you, at the somewhat hard when they measure, it turns out that they're operating about 61 to 85% of their maximum heart rate. That relates to max VO2 this way, 51 to 75% of their max VO2. I'm not sure I made that clear. Because yes, they were talking about percentage of maximum heart rate. And sometimes people use it interchangeably.

Your percentage of maximum heart rate does not equal the percentage of maximum VO2. Generally, a rough guesstimate is about a 10% difference-- that if you're operating at 75% of your maximum heart rate, you're operating at about 85% of your maximum VO2.

Actually, it's the other way around. Let's rewind that. 85% of your maximum heart rate is about 75% of your maximum VO2. So if you're operating at 90% your maximum heart rate, which is really what we're talking about when we talk about, OK, let's really get a great benefit-- 90%, you're nearing lactate threshold-- 95% of your maximum heart rate, 90% will be about 80-85% of your maximum VO2, which is pretty intense.

What they have found is this tends to be very reliable. There's a huge correlation between a person's maximum heart rate and the maximum VO2, and what they pick out on the Borg scale. So this is another possible testing that you can look at.

If you were in a gym, the way you might use this is they would pick this out. I mean, they could pick out, OK, somewhat hard. And while they're doing that, you could almost take their pulse to find out what their pulse is at that particular time, and come up with a training zone that way. Or, you can use a Polaris monitor, if you have money. Have you seen the Polaris monitors? You can strap around the chest and you can actually get readings that way. And you can set alarms on them too. So it will tell you if you're not working hard enough, or if you're working above the target zone. So that can also be beneficial.

And if you look, the rationale, the whole idea is to be able to quantify certain structural components. And generally, with body composition, we're talking about trying to figure out what the percent body fat is on people. So if you look at the assessment-- you can either do direct or indirect assessment. And once again, direct assessment would be much tougher. If you're talking about direct assessment, you're talking about things like taking chemicals which help dissolve different parts of the body and measuring the remains. Or cutting up specific parts. And you can see, there are certain ethical problems doing this with humans. So most of it has been done with animal studies.

But I think they've done some human stuff, or they've tried to with cadavers-- not real living people. They can't bring them back if they do it. And I think death is a long way to go to figure out how much percent body fat you have. So we generally use the indirect methods in here. And some of these assessments, I hesitate to use the word gold standard. But a hydrostatic weighing, using the underwater tanks, is what a lot of things are measured against. But I think there are still some variation on how effective that is.

Now the hydrostatic weighing, what that is, it's based on Archimedes' principle on specific gravity, where they will weigh you outside of the tank, and then they will weigh you inside of the tank. Now to really get accurate readings with this, people have got to become comfortable. Because what you have to do is-- has anyone done the underwater weighing before? We have some people who have done it. To really do it properly, you have to be comfortable in the tank. Because you have to blow out all of your air. And after you blow out all of your air, you have to stay relaxed for five to eight seconds, so they can get a good measurement on the bounce.

Remember, we talked about residual volume yesterday when we talked about pulmonary function. And that's the air that you can't get out. So usually, before you do the underwater weighing as part of the testing, you do a spirometer test so they can figure out what your respiratory volume might be. Then once you get in the tank-- and they try and make it comfortable. They try and have the temperature somewhat like about 95 degrees, if possible, so you're comfortable. And they'll have you breathe all the air out that you can. Then they'll weigh you there. So they have your weight outside the tank, your weight inside the tank-- so you're displacing water. That's how they figure out your weight inside the tank. Plus, they have a residual volume. And they try and come up with a value for you. And that's how the hydrostatic weighing takes place.

Generally, you're only going to see that in institutional areas, universities, colleges. It's not the type of thing you're going to have in your office. Now, they measure everything against the hydrostatic weighing. So when we look at skin folds, the rationale behind skin folds is that your subcutaneous fat is a good indicator of what your total percent body fat is.

The way they come up with a lot of these equations is they will measure people in the tanks. And then they will do skin folds. And they will come up with the regression equation to match what their underwater weighting is. Now, skin folds can be very effective. And here are the calipers. This is an example of the calipers they use.

Now they do sell cheaper models than the plastic ones. And the problems with the plastic ones is they lose their tension quickly. So I think they become unreliable rather quickly, where something like this, you can have constant tension for a long period of time.

Now, how accurate are skin folds and calipers? It depends on who uses them. The more you use it, the more accurate you are. And they feel you can get to within 1 to 2% of accuracy, as compared to hydrostatic weighing. The minimum amount of people you would have to work on to just get a feel for this is probably about 50 people minimum to really get a feel for knowing how to do this. So the skin folds can be very useful.

This goes the concept of, also, if someone is training and working out, that the percent body fat may go down even though they don't change their weight. So if you can give them skin fold values, then they can feel a lot more comfortable with their workouts and how they're doing. You can see, it was very simple. What I did was very easy.

I think there are calipers now-- computerized calipers-- that, as you do it, you can actually get the values. And I don't know how effective they are. If you're in your office, if you do the calipers once and someone else does them a second time, that's not going to be accurate. It's really the same person who needs to do it and needs to have some proficiency with it, who's practiced with it.

Now, the bioelectrical impedance analysis, which you may have seen health clubs-- I think-- tried to use it. And what this is based on is a small current is put through the body. And there's an impedance value. And if you have a higher percent body fat, your impedance will be differently than if you have fat-free muscle tissue. And this is based on the hydration of the tissue.

So what we find here is hydration has a huge effect on this. I would not recommend using the bioelectrical impedance analysis. It's just too varied. The research is not good on this. You can have someone do a workout, and let's, say they did a huge workout and they were dehydrated. They might really be overestimated to what their percent body fat is. Same token is you can have someone who's not in very good shape who may drink a lot and increase their hydration. And they would be underestimated as to what their percent body fat would be.

Ultrasound has also been used. And where ultrasound has come in very handy is for obese patients. Because it's really been able to kind of tease out the different components a lot easier. You could have trouble-- on obese patients, sometimes, the calipers could be tough. It could be tough to get some accurate readings.

CT or MRI scans have also been used to evaluate this. Now, once again, this goes a long way. This is not the type of thing you're going to use for your general patient population. I don't think most people-- well, could you tell me my percent body fat? Yeah, I'm going to send you in for an MRI. There's a point at which it becomes too much.

Also, how many people would need an MRI to know I have to lose a couple of pounds? Most people are very well aware of that. So if you can use something simple like skin folds-- some people have been using circumference measures. I didn't put that in your notes. But have you seen the circumference measures? You'll see the waist/hip ratio. But they also have charts where you can take circumference of biceps, circumference of waist, put them into a equation and also get a pretty decent value for that.

Now the DEXA scan-- once again, I'm having trouble pronouncing some longer words. Remember, when you talk about this versus underwater weighing, underwater weighing is based on some specific assumptions about specific gravity of muscle and bone and fat. But it's not always that clear cut because of the combination of tissue.

Ideally, if you really wanted to figure out percent body fat on a human, you'd probably have to put them in a blender and centrifuge them. And that would give you the most accurate readings-- once again, not very feasible. But waist/hip ratio-- and this was what I was talking about-- with the patient standing relaxed without pulling in the stomach, measure the patient's waist at the level of the navel. Measure the patient's hips over the buttocks where the hips are the largest. And you divide the waist by the hip.

The American Heart Association recommends that a woman's ratio be no greater than 0.8, and the man's no more than 1.0. Once again, a general guideline, but also something you can use in the office, something that's a little bit easy to use very quick.