

LECTURE 2

Static & Dynamic Testing

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Fitness Testing Overview

We now move on to discuss fitness testing, which is a very valuable part of the exercise planning process. Without gaining real information as to the state of a client's fitness you cannot properly programme for their improvement. There are so many reasons to perform a comprehensive fitness assessment at the outset of training with a client. Among the reasons are;

- Goal setting.
- Technique education.
- Needs analysis.
- Current strengths & weaknesses.
- Programme design.
- Professionalism.
- Set benchmarks.
- Manage risk.
- Motivate.

You should consider the client when structuring their exercise testing. Each test should have relevance and be appropriate to the client. For example, if you have a brand-new client it is unnecessary to give them a maximal-effort cardiovascular test as they won't be physically ready for this level of exertion. Another situation you might face is a client who is overweight and doesn't want to have their weight and body fat measured. Try to show compassion in these situations and only administer tests the client is able and willing to undertake.

Static Testing



Static testing refers to non-exertion tests that are designed to collect 'body data' such as blood pressure, body composition, flexibility, circumferential measurements and flexibility.

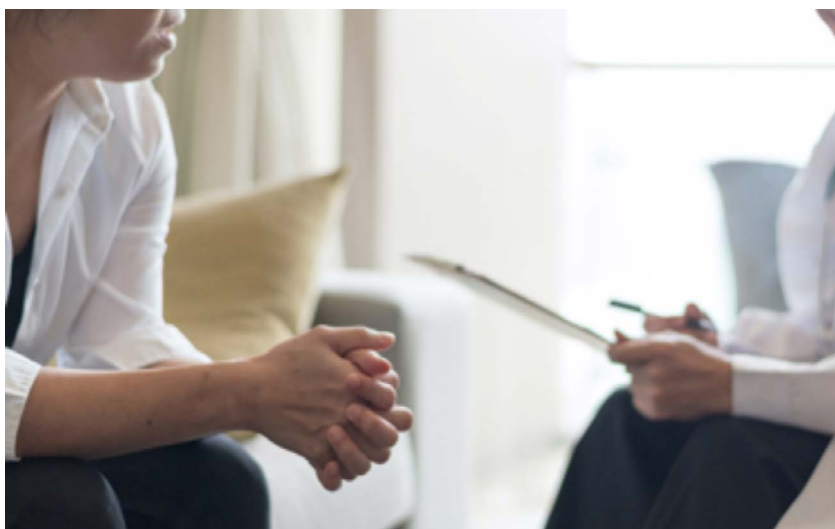
Dynamic Testing



Dynamic testing involves exertion on the client's part. Data around muscular endurance, cardiovascular capacity, muscular strength, and power are all examples of dynamic tests.

Considerations

Client Profile



Ideally, through the process of fitness testing we want to gain a clear profile of the client's current state, their preparedness to exercise, and their current baseline measures.

Informed Consent



We must gain the clients informed consent at the outset of this process. This involves fully informing the client of any and all processes involved in order that they are fully aware. Once we have their informed consent, we can then embark on the testing process.

Reliability & Objectivity



Reliability relates to how consistent a test is over consecutive tests. An example here is whether the scales are calibrated and are reading accurately. If they are not, they would be deemed unreliable. A fitness test's objectivity relates to the likelihood that the test yields the same results despite the tester being different. A robust test should produce similar results regardless of the tester.

Is It Appropriate?



When selecting tests for your client make sure they are appropriate.

- Does the client really need to lift the heaviest weight that they possible can? (This is also called **1 rep with maximal effort or 1RM**)
- Do they need to go to a 10/10 on the rate of perceived exertion (RPE) scale?

Base your decisions on the client's unique circumstances. Also, your decisions need to take into account the goals and objectives of the client. Does a maximal strength test really make sense for a client who is seeking weight loss for example?

Validity



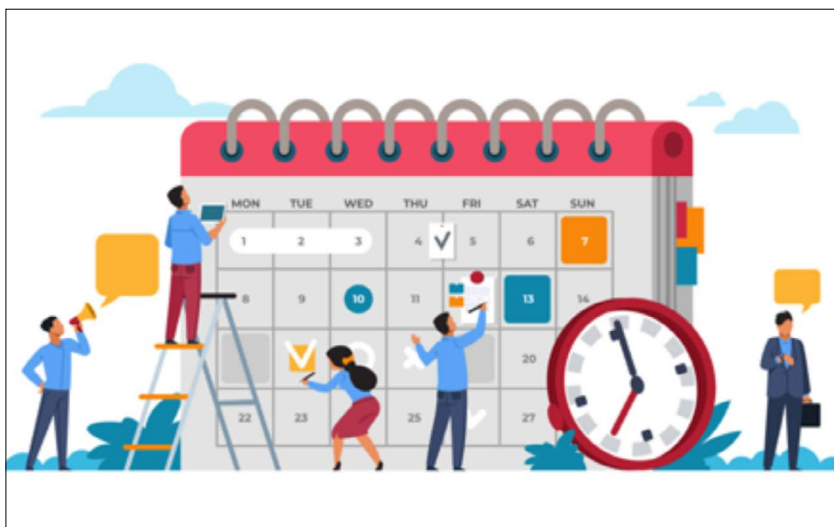
For a test to be valid it needs to have a good level of accuracy in measuring what it is meant to measure. For example, if you choose to perform a jump test make sure you're aware of exactly what the test is giving you information on. Is it their maximal jump height as in a vertical jump, or is it the maximal box jump height which is related to mobility and flexibility at the ankle and hip. An example of when a test may not be valid would be if the client is in a completely different physical state upon a retest. For example, if they are suffering with an illness, the test would not be a fair representation of their ability.

Environment



The environmental factors such as the time of day, temperature, and any other factors relating to the client's preparedness such as sleep, caffeine and level of training fatigue need to be considered and closely replicated in future tests.

Timing



You should remain consistent with the timing of the tests as you move forward with your client. If you test first thing on a Monday morning for one test and then last thing on a Friday night for the re-test 6-weeks later the results will vary based on external factors unrelated to the client's fitness.

Client Considerations



To ensure the greatest accuracy of test results, and the greatest re-test accuracy later on, you should ensure the client is arriving in a neutral state and that this is recorded and repeatable next time. For instance, if they are arriving for testing following the completion of a 10km run the day before then the accuracy of the results will be compromised as they will be fatigued. There should also be guidelines around coffee, alcohol and cigarettes around the testing period as all of these things will affect the results.

Order



If you perform a squat before a cardio-vascular (CV) test on the initial testing process and plan the same exercises for a re-test, then the order should be the same as well. If not, then the exercise that takes place under less fatigue may improve while the second test may not - with the results altered based on fatigue-state rather than training-progression.

Selecting & Administering Appropriate Tests

There needs to be consideration, as to the appropriateness of the testing you apply to the client. This doesn't solely relate to the client and their ability, but does it fit their **needs** and is it **relevant** for their goals.

If their only goal is weight-loss, then it makes sense to prioritise testing around bodyfat percentage and scale-weight as these two measures will give insight into their progress over time.

You might also select tests related to the style of training you will implement with the client. It is unlikely for example, that you will utilise a lot of heavy strength-based training sessions with your weight-loss client. The long rest periods are less likely to enhance the 'excess post-exercise oxygen consumption' (EPOC) effect of training. Therefore, you probably won't spend a lot of time on strength testing.

When you are about to embark on the testing process you should make the client aware of their state so that notes can be taken and a similar state attained next time. This relates to their dietary intake and rest etc.

You should also outline the process and protocols they are going to be performing in the tests. It may be worth doing repeat tests where possible, to ensure there are no anomalies. There are a couple of examples where this would be reasonable.

- One such example would be when measuring blood pressure because people tend to become nervous which would impact the reading.
- Another example would be to gain an accurate measurement as the client becomes familiar with the technique. This may be the case during, say, a sit-and-reach test.

Remember, if you have a collection of physical and static tests to complete, the static ones should be completed first. They will not impact the results of the physical tests, whereas the more intensive testing will potentially impact the static ones.

- For example, if you complete a maximum press-up test followed by a blood pressure test shortly afterwards the BP test loses its validity.

Static Testing

Blood Pressure

Blood pressure can be taken with a cuff manually, or with an automated machine. This is a really important measure as clients may have high blood pressure and be unaware of it. It will also impact your programming as there are specific contraindications associated with high and low blood pressure.

Participants should be relaxed and seated for a few minutes prior to the test. Place the cuff about 2cm above their elbow. It should not be too tight, but tight enough to hold its position. Place the arm on the table with the cable leading downwards towards the elbow. Start the machine and record the results. You should take more than one reading to ensure accuracy.

Most machines will also give the client's resting heart rate reading as well.

Peak Flow

Lung function tests can give an overview of a client's cardiovascular exercise potential. If they have low lung function, then they may have lower capacity to work at high intensity for extended periods.

This test measures the 'forced vital capacity' (FVC) of the client via a Spirometer. FVC relates to the maximal volume of air that can be forcefully expired following full inhalation.

It is important that the equipment is reset and cleaned prior to use, that the test is taken when the client is fully rested, and ideally with them wearing a nose clip also. They should take a deep breath, fully cover the mouthpiece with no gaps, and breath out fully and forcefully. This test may require repeated efforts in order to be certain of the result.

Body Statistics

You can measure the client's height and weight for an understanding of their current measurements. If using scales, make sure they are on an even, hard surface and that you use the same scales, as well as ideally the same time etc for re-tests. Once you have the client's height and weight you can calculate their body-mass index (BMI), which offers an indication of their current health risk.

BMI is calculated by using the following equation –

- Weight in kilograms divided by height in metres, squared.

It is accurate for the majority of people but not for those who weight-train regularly as the added muscle mass will leave many people in the overweight or obese categories muscle is heavier than fat).

Range Of Motion (ROM)

Static ROM

For this type of measurement, you might choose to use a manual or electronic goniometer, which measures joint angles. It can also be completed without this equipment with estimations of ROM but it will be less accurate.

Sit and Reach

The sit and reach test measures the flexibility and mobility of the hamstrings, hips and low back. Following a warm-up the client should move slowly to a stretch position without bouncing and hold for a few seconds. The client should keep their feet flat on the foot plate without shoes, while we record the furthest distance they can reach and hold. We can adapt this test to focus primarily on the hamstrings by ensuring the client maintains a consistent and natural lumbar curve while they complete the test.

Composition

Body composition is a measurement that details all the various component materials your body is made of - muscle, bone, fat and water. The healthy figure for adults rises slightly with age and is typically agreed to be between 21-36% for adult females, and 8-25% for adult males.

There are different ways you can have this measured as detailed below...

- **Skinfold Tests**

Inexpensive and relatively easy to operate, skin-fold callipers can be used to calculate the percentage of subcutaneous (under the skin and on top of the muscles) fat an individual has. The difficulty in measurement is in the accuracy of the tester in finding the correct locations to measure. The tester should lightly grasp the skin of the client between their thumb and forefinger using a slight rolling action to be sure they are holding only fat, and not muscle. The callipers should be placed slightly separate from the finger and thumb and the measurement should be read and recorded. This should be retested two more times following a short rest so that the site can return to its normal state, to ensure accuracy. The combined millimetre measurements of all skin fold sites can be added together to give the client a total figure to be viewed against their age in normative data charts related to the specific test (there are many different tests with varying numbers of skin fold sites).

- **Bioelectrical Impedance**

This type of body composition testing is becoming increasingly commonplace in health clubs. It is simple to use, non-invasive, quick to administer, and can offer a wide range of different results. The principle is that the machine initiates a current in the body, and that the resistance it faces varies between the different materials the body is made of. This feedback offers insight into the fat mass, and lean-body tissue that the client's body is composed of.

There are many different methods that utilise bioelectrical impedance, including portable machines, weighing scales, and more commercial units. They all operate under the same principles, yet they may vary in quality and accuracy. The general advice of using the same equipment, and same conditions, for the initial test and the re-test should offer an element of reliability to the results, even if they are not perfectly accurate.

- **Circumference Measurements**

People store their fat mass in different areas of the body. The site of fat storage can indicate an individual's health risk, hence it can be an important measurement to take. A good measure of health risk is the waist - hip ratio. This measurement also offers a good insight into the client's progress over time - when people lose weight they may lose inches, so by measuring specific sites we can see that they are progressing. Waist circumference is also a good indicator on its own accord as fat stored in the midsection can act as a risk factor in cardiovascular disease.

When taking a circumferential measurement, it is important to ensure the tape measure isn't twisted on the skin and that it is not pressing into the skin either. The client should be standing, with their body relaxed. When measuring the waist, you want to measure the narrowest point between the lowest rib and the top of the pelvis.

Posture Assessment

Running an assessment on posture, both as a static image, and in terms of your client's dynamic movement can be valuable as it will allow you to understand their potential movement compensations, areas of tightness and weakness, potential restrictions, and areas of potential pain. If you can integrate this practice as a part of your fitness-testing process it will add considerable benefit to your programming.

Let's look at this in practice.

- You can run a static postural assessment and make note of the relevant points.
- And you can also run a dynamic postural assessment which takes into consideration how your client physically moves. You will want to perform this unweighted so that there is less risk of injury.

We will have a look at the squat and the lunge here to highlight some of the take-away points you can see. There is an optimal and a sub-optimal way of performing every exercise but using poor technique due to muscular compensations and poor postural control will likely lead to over-reliance on the wrong muscles, and potential injury.

Squats

The areas of concern are the upper and lower back in terms of being able to hold a neutral spinal alignment, with lumbar arch. This will allow an appropriate dissipation of force across the body's structures.

In addition, a restriction in dorsiflexion can lead to the heels being lifted which will shift the bodyweight forward to the ball of the foot and place more pressure on the knees.

The head should be largely in line with the shoulders and the heels, with the knees ahead of this imaginary line, and the hips behind it.

Lunges

Tightness in the hips can lead to an anterior tilt being presented on a lunge, and the body leaning ahead of the midline, limiting its reliance on the rear leg.

Poor scapula control, coupled with this forward lean can result in the upper body falling forward over the lead leg which places a lot more pressure on this leg to stabilise and support the body.

The torso should be upright and evenly balanced between the lead and rear legs, with the weight on top of the hips and the spine in a neutral position.

Press-Ups

With press-ups there are lots of potential issues, either related to posture or core control and stability.

The head, shoulders, pelvis, knees and ankles should all be in line with each other. When there is deviation from these positions, we will see additional stresses added.

A common fault is for the hips and midsection to be dropping. This will place pressure on the lower back and form a far greater demand on the anterior core musculature to stabilise the body. As compensation, we see the head rise and there will be greater stress at the lower leg because the entire leg becomes closer to the floor, and closer to parallel.

Another fault is that the head drops and the hips rise. This may be due to weakness in the core, or tightness in the hips not allowing the body to descend into a straight line.

Scapula control can be an issue also. If they are not adequately mobile and cannot retract and depress, then the shoulders will take far more stress than they should have, as the chest muscles cannot become as engaged as necessary.

Plank

Issues performing a plank correctly are similar to those involved with a press up. In a plank, the weight is supported equally between the hands or elbows and the feet.

The body should be in a perfectly straight line, with the hips neither sagging towards the floor or raised up above the body line. Core muscles should be engaged to maintain the position for the required length of time.

Dynamic Testing

Here are a few examples of some of the dynamic fitness tests you might include in a client's testing stage.

You can find a greater range of tests all described in detail in the Supplementary Lectures section: Lecture 8 – Fitness Tests.

Movement Screening

Movement screening is an excellent way to assess how well your client moves and to see if they have any postural issues or muscular compensations that you can help to address in their training.

Coupled with a static and dynamic postural analysis, movement screenings (there are lots of them available) can offer a good insight into how your client moves, and what training modalities will suit them.

Jumps

You might choose any of the following, or a range:

- **Repeated box jump height** - measures the client's ability to reach and maintain their output (muscular endurance).
- **Max box jump height** - this will speak to the power the client can create in a single jump, as well as offer an insight into their flexibility and mobility at the hip, knee and ankle.
- **Broad jump** - horizontal distance jumps require a countermovement followed by forceful and explosive 'triple-extension' (ankles, knees and hips) and are another good way to measure power production.
- **Vertical jump** - this measures the 'real' height the client can jump.

A box jump measures how high they can jump, tuck and land, whereas with a vertical jump we make a mark on the wall at their highest standing reach (i.e. the highest place they can touch with the tip of the middle finger,).

Then they jump as high as they can (maximally) and mark where the middle finger touches at the highest part (the apex) of the jump. You then measure the difference between the two marks.

This gives us their maximal jump height.

Muscular Strength & Endurance

Here you can choose:

- **Rep-Max**

This will be best suited to compound exercises (i.e. exercises using several muscles collaboratively). This is how you handle more weight without compromising technique, and should only be performed by experienced clients - and only if it is appropriate health-wise and for their goals.

In terms of protocol the skill lies in being able to reach and test the rep range you are working towards, arriving at the maximum effort without any undue fatigue. Basically, you don't want to exhaust the client before they perform the actual test!

So, if you know their maximum bench press is around the 100kg mark for 3 reps you want them to be sufficiently warmed up through progressively heavier efforts.

However, you don't want them to perform lots of reps at every 10kg increment along the way (i.e 50kg, then 60 kg, then 70 kg, then 80kg, then 90kg), or they will be fatigued prior to their maximum effort.

- **Max Reps**

The instructor needs to be confident in the client's technique and stop the test if this starts to fail. The idea here is to see how many reps the client can perform for a given exercise with a specific weight - or using bodyweight. If this number increases over time with the same weight, it is a good indication that the client's muscular endurance is progressing. Press-ups, sit-ups and chin-ups are good choices for bodyweight exercises, while most exercises using free weights and machines are suitable, providing the technique is right, and the weight selected is appropriate.

- **Timed Efforts**

For exercises such as the plank or the back extensor test, it can be good to see how long someone can maintain their form. For exercises such as press-ups and sit-ups, performing maximum reps in a given timeframe can be a useful measure of muscular endurance, providing the technique is good. This allows the participant to take breaks as and when they need to and accumulate maximum reps in a given timeframe.

Be aware that there are some clients, such as those suffering with hypertension, for whom isometric exercise will not be suitable.

Cardiovascular Testing

Among the tests you may choose to do are:

- Resting heart rate
- Rockport walking test
- Harvard step test
- Cooper 1.5 mile test
- Cooper 12-minute run

You might also choose to design and implement your own cardiovascular test. Remember to create a repeatable protocol so that it is valid.

Here are the processes for a couple of the tests highlighted above...

Rockport Walk Test

For this test you walk as fast as you can for one mile. Following this you record your time as well as your pulse immediately following completion of the test. You can then check your predicted VO₂Max by using the following (rather complicated) equation:

132.853 minus (0.0769 multiplied by your weight in pounds)

Minus (0.3877 multiplied by your age)

Plus (6.315 if you are male or 0 if you are female) minus (3.2649 multiplied by your walking time)

Minus (0.1565 multiplied by your heart rate at the end of the test)

Harvard Step Test

The heart rate will rise in response to exercise stress and demand, and therefore we make the assumption that more oxygen is being consumed during exercise. So measuring heart-rate response to exercise has validity in measuring how fit someone is - the assumption being that the heart rate wouldn't rise so much in a fitter individual subjected to a standardised workload.

For this test the participant uses a 22 steps per minute rate (for women) or 34 (for men), while stepping on and off of a 40cm box for 3 minutes. The participant steps on with one leg, then the other, and then down in the same manner.

Once completed the heart rate is taken in order to be able to use it in the following equation...

Men VO₂Max = 111.33 minus (0.42 x beats per minute [BPM])

Women VO₂Max = 65.81 minus (0.1847 x BPM)

Cooper Tests

There is the 1.5 mile test and the 12-minute run. For both you want to have a warmup prior to taking the test.

Cooper 12-minute Run

Following the warm-up, the participant is simply to run or walk as far as they can on a track or treadmill for 12-minutes.

Cooper 1.5 Mile Run

Following the warm-up the participant completes 1.5 miles in as short a time as possible.

These tests are used to estimate the cardiovascular fitness of the client. To calculate this, there are many tables on the internet for the Cooper Test targeted at different groups - males, females, different age ranges and so on.

There is obviously an inherent risk with any fitness testing that requires exertion. When designing an appropriate range of tests, you need to consider the client's training age, training status, functional ability, experience and technique as well as the results of their PAR-Q, and their goals etc. The tests should not only suit their needs, but also not put them under any serious risk.

Testing Cycle, Progression, Benchmarks and Retests

Fitness testing should follow a fairly cyclical process. You should outline the initial testing process, and the assessments you are going to perform, marking down the environmental and client factors in order that they can be replicated later on.

- Collect and analyse the results you get from the tests, identifying areas of strength and weakness, as well as those areas that you will work to improve in the subsequent programming.
- Following programming for progression you should set a date for retest in order that you can judge the effectiveness of the programme and lifestyle changes the client has made.
- You should use the re-test as an opportunity to identify the parts of the programme that have been a success, as well as those that require amending.
- Inevitably there will be areas of the programme that could be fine-tuned to deliver better results, and it is important that we discuss these areas with our clients during further consultations so that they understand the reasons for programme amendments.

Clients' goals change and expand as their training progresses. They will potentially have varying needs, availability, motivations etc as they become a more regular exerciser, and we should support this by making adaptations to their training plans to suit them best.

Dynamic testing can cause tremendous strain and stress for the client. For this reason, you should keep the client's safety as top priority and stop the testing process immediately if any of the following issues arise...

- Chest pains of any description.
- Client feels sick or nauseous.
- Light-headedness, dizziness or feeling faint.
- Any significant change in blood pressure – increase or decrease.
- Either red, or cold, clammy skin.
- Shortness of breath.
- Equipment stops working.
- Signs of severe fatigue.
- Client wants to stop.
- Injury occurs.
- Irregular pulse.
- Serious arrhythmias.

