

## LECTURE 1

# Introduction to Principles & Components of Fitness

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# Principles & Components of Fitness

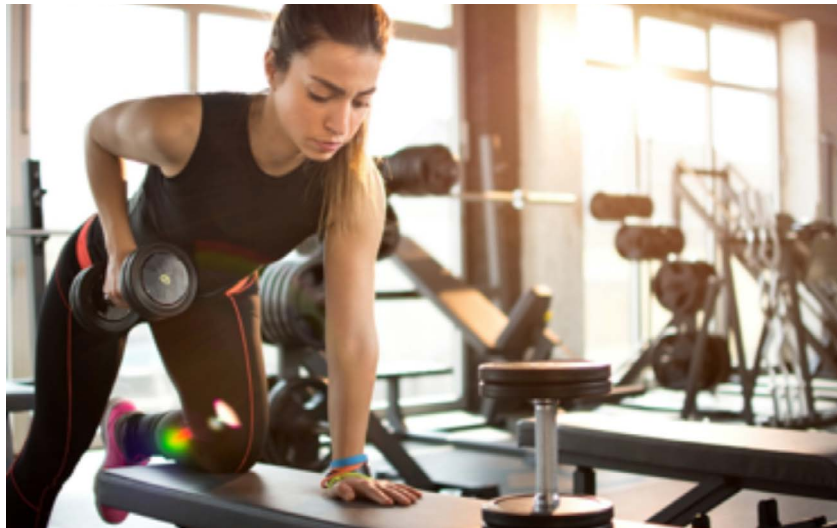
**In this lecture we give you a basic introduction to the components of fitness. Fitness means a great deal of different things to different people so it stands to reason there are multiple facets that we can focus on. We will explore them all now...**

We can define fitness in different ways - such as...

- The ability to successfully adapt to specific physical stressors.
- The performance of specific physical demands in an exercise setting.
- The performance of day-to-day tasks without excess fatigue.

The above is a reasonable place to start in terms of defining, and identifying fitness but what about the specific characteristics or attributes? Well, we can consider the following aspects if we want to identify all of the varying aspect of fitness:

## Monitoring



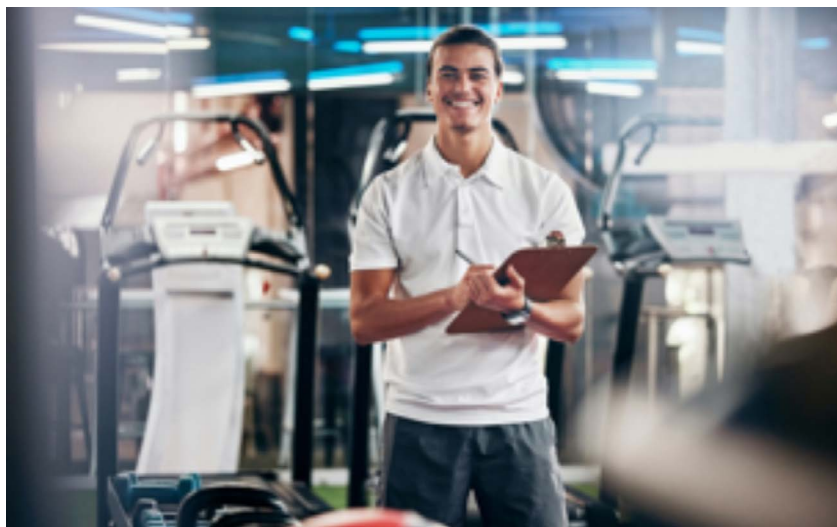
Physical fitness encompasses all the measurable attributes that we typically associate with training progressions... muscular strength, muscular endurance, flexibility, cardiovascular endurance etc.

## Skill Related



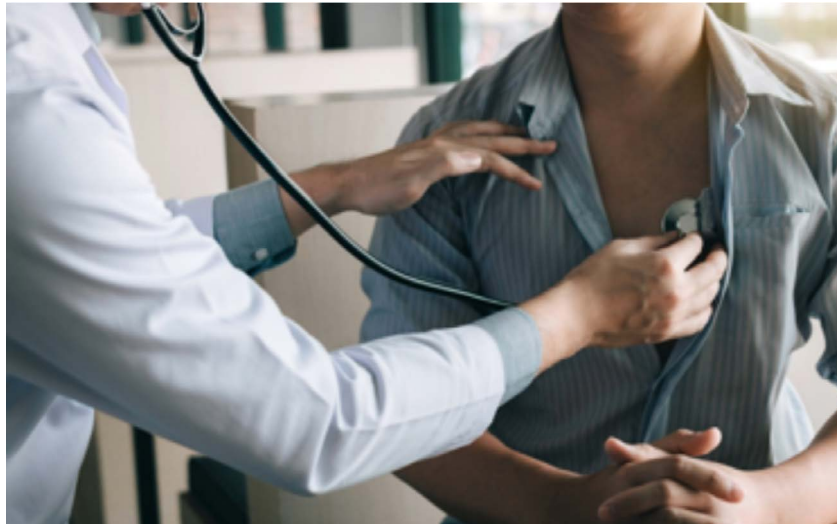
Skill-related attributes include balance, coordination, agility, power, speed etc. These can also be referred to as **motor skills**.

## Emotional



A positive mental state indicates a healthy mental and emotional fitness. Mental and emotional health assist in creating a holistic fitness in mind and body.

## Medical



The definition of medical fitness would be the absence of illness and disease. This doesn't really speak to your overall fitness in an exercise setting but obviously is a desirable outcome health-wise.

## Nutritional



Following a healthy, nutritious diet composed of adequate macro and micronutrients fuels the mind and body well. Remember this will also include a balance of foods rather than referring to a restrictive diet.

## Social



Being able to interact with others using good social skills to form relationships.

Obviously we, as personal trainers, can have an impact on all of the above but mainly on the physical, skill-related and nutritional aspects, as per the limits of our job roles..

# Components of Physical Fitness

**The next thing for us to do is explore all of the various components that comprise Physical Fitness, of which there are FIVE...**

## 1. Cardiovascular

Cardiovascular fitness is related to the heart and lung's ability and efficiency in delivering oxygen to the working tissues - and removing carbon dioxide. With continued training the efficiency improves, based on decreased resting heart rate, increased stroke volume and greater capillarisation within the tissues, which all enable the muscles to do more work.

Cardiovascular efficiency can be measured as VO<sub>2</sub>Max, which measures the volume of oxygen an individual can take in and use during training.

## 2. Muscular Endurance

Endurance in a muscular sense relates to the ability to repeatedly perform a task over a prolonged period. This might be in an exercise setting or it might be in an everyday setting such as gardening or hiking - or even the ability to maintain good posture throughout the day.

Muscular endurance training is associated with low weights and high reps and may result in **delayed onset muscle soreness (DOMS)** if the exercise is taken to fatigue.

### 3. Muscular Strength

Muscular strength can be defined as the maximal force that can be produced by a muscle or a muscle group. The main benefit is that it makes sub-maximal efforts easier to manage, hence lowering the stress of other tasks that a person faces on a day-to-day basis.

Strength can be measured or estimated using maximal or sub-maximal loads and can be trained through progressive overload with high weights and low reps.

### 4. Composition

Body composition speaks to the relationship between fat and lean body tissue. This is heavily influenced by the exercise stresses, and subsequent metabolic impact of the training. Diet and general lifestyle play a major role too. A high level of body fat will not only damage fitness levels and the ability to perform physical activity but will also play a major role in increasing disease risk.

For many people the weight on the scale is an important number but it is far more important to consider the body composition. Consider someone who has a lot of muscle and low body fat. The scale will give a value to their body mass only which doesn't speak to their overall health.

### 5. Mobility

Flexibility and mobility are related to the range of motion available around a joint. This is essential in an exercise setting if you want to gain more from your training. Consider two people squatting - one with greater depth than the other due to hamstring flexibility and hip mobility. The person with greater depth will increase the stress related to the exercise and will therefore get better results. On a more basic level, stiff muscles and restricted joints can also impact posture and potentially in turn, exercises such as running, which rely heavily on thoracic extension and the chest cavity being able to expand.

## Components of Physical Fitness

**Next, we can have a more in-depth look at the components of fitness related to skill.**

**There are SEVEN skill-related components of fitness and they are linked to the performance of specific tasks and how well all of the body's integrated systems work together to perform tasks...**

#### 1. Speed

This is related to the speed of movement. Consider someone sprinting or throwing a baseball – both these tasks require speed, yet their outward appearance and execution are very different. The ability to generate speed is linked to how well the nervous system coordinates the muscles, and what fibre-type dominance the individual has.



## 2. Power

Power is the expression of high force *rapidly*. Both strength and power are very closely linked in that they both require coordination of the nervous system and musculature. However, power is expressed far faster than speed.

Let's look at the difference between a deadlift and a box jump. Both these movements require hip and knee extension, but the deadlift expresses this slowly and has a clear end-range of motion. The box jump expresses force through the **end range of motion** as the person leaves the floor. This requires rapid force-production using the same joint actions as the deadlift.

A big difference in power and strength, in addition to movement speed, is the inclusion of a counter-movement. You often see a rapid counter-movement in jumping exercises. This utilises the stretch-reflex in the muscles that enables the muscles' elasticity to be utilised.

## 3. Co-ordination

Coordination is the ability to move the limbs in a precise manner. In a sporting sense we see high-level examples of coordination on display. Consider a sport such as tennis in which a player may need to move their body in one direction while swinging their racquet in a different direction.

## 4. Reactions

Your reaction time is the ability to respond to a stimulus. Again, we see this at a high level in sports all the time. There are situations such as in a sprint where we see the athletes respond to the starter's pistol. There are also other examples in sports that are more unpredictable where we see great examples of reaction times also.

Let's look at football where we may have a defender and an attacker. The attacker will at some point make a move to go past the defender, which will require a fast response.

## 5. Proprioception

Proprioception relates to your understanding of your body in space. For example, once you have attained good technique in a squat you can replicate this time after time. Your ability to understand your range of motion, depth and where the body is in space all lead to success in this exercise. You will be able to perform this task based on your **feel** rather than conscious consideration.

## 6. Balance

Balance is the ability to maintain equilibrium. Many sports require high levels of balance, such as gymnastics. Also, many fitness disciplines such as yoga utilise balance in their practice. It is also important for older adults to maintain good balance to lower the risk of falls.

## 7. Agility

The ability to rapidly change direction at speed. Again, this is something we see in a sporting setting often.

## **So...what factors influence our health and fitness?**

### **Age**

This is related to the speed of movement. Consider someone sprinting or throwing a baseball – both these tasks require speed, yet their outward appearance and execution are very different. The ability to generate speed is linked to how well the nervous system coordinates the muscles, and what fibre-type dominance the individual has.

### **Gender**

Men tend to excel more at strength-based pursuits while women perform better at endurance and tend to have greater flexibility. This is only a general rule and both sexes can excel at all disciplines of course.

### **Body Type**

Being an ectomorph, endomorph or mesomorph will impact the type of training you will excel at.

Mesomorphs tend to be more heavily muscled with low bodyfat. They will tend to excel at events that require higher strength to weight.

Endomorphs are generally predisposed to fat storage but can be very athletic. Events such as weight-lifting will often be dominated by this body type.

Finally, ectomorphs tend to be slim and lean with narrow shoulders and hips. Longer duration events are usually the sorts of athletic pursuits ectomorphs excel at.

### **Nutrition**

Your diet and nutrition will contribute heavily to your health and fitness results. You can train really well but if you have a poor diet, you might fuel the session optimally or recover well.

### **Activity**

Activity – fitness takes time and consistency. You can overdo the exercise stimulus and train too much, and you can absolutely train too little. It is important also to make sure you are starting a habit you can continue. It is too easy to fall off the pace because you have taken on too much.

### **Disabilities**

Disabilities can make a big impact on health, fitness and performance. Of course, people with disabilities can be incredibly fit and athletic. It is important that when planning exercise programmes, that you accommodate as best you can the individual's specific disabilities and circumstances.

### **Health**

Illness can have a huge impact on fitness and health. We need to ensure we are training our clients wisely and if they need to rest to recover that we enable them to do so.

### **Medication/Drugs**

There are many people who take prescription or recreational drugs, of which alcohol is one. Your clients need to be honest with you at the outset about where they stand on this. Many drugs and other medications have contraindications for exercise that you need to be aware of in your programming.



## **Stress**

Stress is a major presence in many people's lives. Work and life stresses can cause issues with sleeping, hormonal disturbances and can also lead to other negative lifestyle choices. Exercise is a great strategy for stress management, including disciplines such as yoga etc. It is important that we don't add to the stress too much with our training load and intensity.

## **Environment**

Environmental factors will play a role in a person's exercise regime. If they live in an area with lots of natural surroundings, they may find walking and running outside easier than living in a built-up area for example. Weather, traffic and local facilities will all impact here.

**It can seem that exercise benefits require an enormous change in lifestyle. However, there are health benefits to be had through moderate activity for 30 minutes most days. This will increase with additional activity for longer periods or higher intensity.**

Here are some of the benefits...

- Reduction in mortality rates.
- Reduced risk of death from any cardiovascular complications, hypertension and stroke.
- Lower risk of many forms of cancer.
- Reduction in osteoarthritis symptoms as well as lowered incidence of osteoporosis.
- Greater stability and reduced risk of falls in older adults.
- Lowered risk of obesity and weight gain and greater chance of weight loss.
- Helps manage symptoms of Type 2 Diabetes.
- Improved mental health, encompassing many different benefits including management of anxiety and depression.
- Increased quality of life.
- Increased BMD (Bone Mineral Density)

**We will now look at the principles of fitness that will have an effect on your programming...**

## Specificity



For the body to adapt in a specific manner it needs to be given the correct stimulus. You need to consider muscles involved and the fibre types etc that will be recruited. This can also be seen in cardiovascular exercise. If you want to be a better weight lifter you need to lift weights. You can run on the treadmill and experience some progression in your CV system but it wont make you a better weight lifter.

The spinal cord takes care of many 'reflex' actions which don't necessarily need deeper analysis. The spinal cord is also the bridge that connects the brain with all of the nerves in the body.

## Adaptability



Linked to Specificity, the principle of adaptability is centred around the fact that the body will adapt to the specific demands placed upon it. If you focus on certain muscle groups or types of exercise then you will experience progression in these specific areas. The prior example of the CV benefits of running not overlapping into your swimming performance is a good example here too.

## Overload & Progression



The body will experience a fitness plateau unless the exercise stimulus is progressed periodically. The body needs to experience overloaded stimulus over time to continue to progress. Too much overload will result in soreness and potentially injury. We must work to offer our clients the chance to exceed their prior limits by a little in order to progress well.

## Individuality



This principle speaks to the fact that every person needs an element of unique exercise prescription. We cannot expect every person to respond in the same way to the same exercises. Some people will respond fantastically to deadlifts, but aren't very good at squatting for example. The same stands for their rate of progression within the framework of the FITT principle. You need to consider this when programming for clients.

## Recovery Time



Rest holds just as much value to a well-structured exercise programme as the actual training does. You cannot work hard in the gym every day without recovery. The value of the sessions will drop and with it you may find your clients showing signs of overtraining. There are lots of factors to consider when assigning rest to the overall training schedule but we must consider rest as a very important addition.

## Reversibility



The principle of reversibility is that regression is absolutely possible based on periods of inactivity. We cannot expect to maintain all our fitness progressions if we don't maintain them with consistent training stimulus and adequate nutrition. For example, if you have added muscle to your frame and stop weight training it should be expected that your muscle mass will diminish over time.

# Exercise Effects

Exercise obviously has beneficial, wide-ranging effects on the body. Dependent upon how we train we will see different results. The effects we see can be split loosely into two categories, regardless of what the actual goals and outcomes are – **short-term and long-term.**

During exercise we experience the short-term effects. An example of this would be an increased breathing rate, heart rate and sweat response as a result of a bout of cardiovascular (CV) exercise. In the long term for CV exercise, following several sessions, we would expect to see a decreased resting heart rate as a result of increased stroke volume. We would expect the same intensity level to feel easier also.

In truth, despite how interesting the body's response to exercise is in the short-term most people begin exercise to enjoy the long-term effects...

**So let's have a look now at the long-term effects of aerobic exercise on the various systems of the body - starting with the cardiovascular system.**



## Cardiovascular System

### Heart

- Ventricular hypertrophy - an actual increase in the size and strength of the cardiac musculature.
- Increased venous return, meaning reduction in blood pooling.
- Increased stroke volume.
- Increased cardiac output (blood ejected per minute).
- Decreased resting heart rate.

### Lungs

- Increased tidal volume and vital capacity.
- More efficient gaseous exchange in alveoli.
- Increased capillarisation around alveoli.
- Improved function and strength of respiratory muscles.

## Blood Vessels

- Improved circulation.
- Increased efficiency of vasoconstriction and vasodilation processes.
- Increased capillarisation and increased mitochondria.
- Increased blood volume including red cells for carrying oxygen.
- Reduced systolic and diastolic blood pressure.

## Metabolic Function

- Increased insulin sensitivity.
- Reduction in body fat.
- Increased VO<sub>2</sub> max.
- Greater EPOC effect (excess post-exercise oxygen consumption) meaning better metabolic function.

## The changes aerobic exercise can bring about in the skeletal system?

### Short Term

- Increased synovial fluid production as a result of movement.
- Potential increase in range-of-movement (ROM) dependent upon the type of exercises included in a warmup or main session.

Synovial fluid is secreted during exercise to nourish and protect the joints and to provide pain-free frictionless movement. It is one reason why you always want to warm up well prior to exercise as this helps the body fully prepare for the session ahead.

### Long Term

- Stronger structures over time - including connective tissues.
- Increased bone mass based on stresses placed upon the skeletal system.
- Reduced sarcopenia.

It is generally acknowledged that these benefits will be enhanced when people undertake some form of impact and resistance training. You should assess the individual you are working with in terms of their training status prior to placing too much demand upon them, but generally speaking we should ensure all of our clients have some resistance-based exercise in their programmes to ensure strong skeletal structures.



**We will now look at the effect training has on the muscular system... both aerobic and resistance.**

## **Aerobic Effects**

**In the short term (during exercise) the following adaptations are made...**

**Vasodilation** – blood vessels allow more blood flow to the working tissues.  
Possible DOMS (delayed onset muscle soreness).

**Blood pooling** – possibly leading to dizziness, hence the need to cool down well following exercise.

**Increased muscle temperature.**

**Increased muscle power.**



When we exercise, we preferentially divert blood to the working tissues. When we are exercising, we have several mechanisms that return blood to the heart. However, if we stop too suddenly we will still have a high volume of blood being pumped towards these tissues with less of a mechanism for its return. This can lead to dizziness and nausea. For this reason, it is important to include an appropriate cool down in your session based in intensity and duration of effort.



# Long-Term Effects of Exercise on Muscles

- Decreased nervous inhibition – in short, the nervous system will allow the muscles to work more towards their capacity.
- Increased size and strength of muscles – hypertrophy.
- Improved posture – if the training is balanced.
- Increased glycolytic reliance in training meaning the muscles can work harder for longer.
- Lactic acid causes less stress to the exerciser.
- Better synchronisation of motor units.
- Greater storage of glycogen and creatine phosphate, meaning you have the tools to work at a greater capacity.
- Greater capillarisation and mitochondria – mainly in Type 1 tissue.
- Increased tendon strength.

**As well as those listed above, there are some extra benefits...**

## **Muscle Size**

Muscle hypertrophy due to increases in number and size of myofibrils, or potentially due to greater glycogen and subsequent water retention in the muscle cell. Both these mechanisms can lead to muscular hypertrophy.



## **Motor Neuron Adaptations**

Your nervous system will become more efficient at recruiting the muscles it needs for a given task. This means the recruitment will become faster and potentially better synchronised. This all may lead to strength improvements. In effect your nervous system becomes more adept at using your muscles.

## **Hormonal Response**

It's important to view exercise as a stimulus. This stressor demands increased activity from the body to repair and recover. Resistance stimulus demands that the body learns to better deal with future efforts. Based on this you may secrete more testosterone and growth hormone as a result of training, which will give the body the environment it needs to repair and recover.

### **And finally...**

- Decrease fat tissue and body fat percentage.
- Increase self-confidence.
- Become more robust and potentially lower injury-risk.
- Increase strength, power and endurance.
- Improved body awareness and motor skills.
- Increase metabolic rate.
- Increase mobility and flexibility.

**Following a bout of strenuous exercise is it common for muscles to experience delayed onset muscle soreness (DOMS). Periods of intense exercise, or a change in training volume may result in damage at a cellular level in the muscles, which is linked to DOMS.**

## **Important Terminology**

There is a whole host of acronyms, important words and general terminology that is important to know as a personal trainer, some of the most common ones that you will encounter are listed below.

### **Intensity**

Intensity refers to the percentage of maximum effort that someone is working at, with 100% being max effort. The higher the percentage the higher the intensity.

### **Load**

Load refers to the amount of weight that is being lifted - in strength training in particular as the overall load is important.

### **Agonist**

This is the prime mover in an exercise, the muscle that is targeted the most. For example, in a bicep curl the agonist would be the bicep.

### **Freeweights**

These are weights that are portable (not fixed) and have total freedom of movement. A few examples would be dumbbells, barbells, kettlebells, sandbags or medicine balls.

## **Resistance Machines**

Resistance machines have a fixed plane of movement, making them great for beginners or people with injuries - as well as those looking to target specific muscles.

## **Volume**

Volume refers to the total weight lifted during a workout or programme. This is calculated across all sets, reps and number of sessions. To progress on any given programme you need to be able to increase the volume whilst staying within the rep- range parameters. This can be done by increasing weight, increasing reps or even decreasing rest time.

## **Fixator**

The fixator is the muscle that stabilises a joint moving during an exercise. Using the bicep curl as the example again, the deltoid would be the fixator.

## **Compound Lifts**

Compound lifts are exercises that involve the use of more than one muscle group. They should take priority as they offer more benefits but are also more taxing. Some examples are deadlifts, squats, bench press or a bent-over row.

## **Antagonist**

The antagonist is the opposing muscle to the one that is working during an exercise. If the antagonist does not elongate during an exercise, then it is not possible for the agonist to contract and perform a movement. During a bicep curl the tricep is the antagonist and will lengthen as the bicep contracts.

## **Reps**

Reps, or repetitions is the number of times that you perform an exercise.

## **Rest**

Rest is the amount of time that a client will rest either in-between sets or in-between exercises. Rest is important as the amount of rest can vary dependant on the intensity of the exercise. Rest can also be used as a tool for progression, either shortening rest time, removing it all together or increasing it to allow for more overall load.

## **Isolation Exercises**

Isolation exercises are exercises that target a single muscle or joint - for example bicep curls, leg extensions or lateral raises.

## **Repetition Maximum (RM)**

Repetition maximum (or 'rep max') refers to the total number of reps you can complete in a set before reaching failure.

It can also be used to refer to the total amount of weight you can lift for a specific number of reps - for example a 1 Rep Max or 3 Rep Max.

RM can also be a useful indicator of Intensity to aim for when programming - for example instructing a client to aim for 60% of their 3 Rep Max for 6 Reps.

## **Synergist**

The synergist is any muscle that supports the primary muscle group in a movement. For example in a bench press the triceps are a synergist muscle as they help you to approach the top of the rep.

## **Sets**

Sets refers to the total number of repetitions you need to complete in one go without stopping. For example 8 reps of bench press would be 1 set. Sets are then used to create your work-out structure - for example 3 x 8 on bench press would refer to 3 sets of 8 reps.

## **Hypertrophy**

Hypertrophy refers to muscle growth in its simplest form. There are typically 2 types of hypertrophy that both result in muscle growth. **Sarcoplasmic** hypertrophy is an increase in the fluid within the muscle tissue.

**Sarcomere** hypertrophy is the result of a greater mass of actin myosin filaments within the myofibril.



# **Types of Resistance**

## **Free Weights**

Barbells and Dumbbells - These are portable weights that offer great freedom in movement capability. Free weights demand better balance and coordination as well as offering the added benefit of training the stabiliser muscles. In addition, almost all free weight exercise will train the core musculature.

## **Body Weight**

Bodyweight training offers benefit in terms of being able to exercise at home and also offers a high level of self-mastery. It is a good feeling to be able to lift your bodyweight.

The restriction is being able to effectively train for a variety of goals as the load/resistance is harder to vary to achieve the required overload.

## **Small Equipment**

Slam balls, medicine balls, kettlebells and suspension training kits are some of the alternative options you have when training clients. The benefits are that they are portable and don't require a lot of space.

## **Resistance Machines**

Machines offer a fixed path, meaning they are a great way to train the primary target muscle without the stabilisers fatiguing. Can also be good for beginners who may not yet have the required stability and coordination to use free weights.

## **Isometrics**

Isometric exercise is work against a fixed resistance, or a stationary position such as a plank or a wall-sit.

These exercises can be great for working on muscular endurance but shouldn't be used with hypertensive clients as there is a risk of elevating blood pressure high due to their being no pause in the intensity.

## **Banded Resistance**

Bands offer a unique style of resistance - they get heavier as they get more stretched, which usually coincides with you being at a stronger, more advantageous position. For example, if you're doing a bicep curl it will be loosest at the bottom position where you are mechanically weakest. You will feel more resistance at the top of the movement where you have a mechanical advantage.

