

**FORTH EDGE<sup>®</sup>**

Fine tune your body:

# A guide to biomarker tracking



# Optimise your performance

Here at Forth Edge we're on a mission to help you understand your body like never before.

**It's likely you already know lots about your heart rate, miles, speed and watts, but how much do you really know about what's happening to your body on the inside?**

That's where biomarker tracking can help. By testing and tracking your body's key biomarkers, it is possible to gain valuable information into whether you are over-training, at increased risk of injury or if your body is fatigued. This will not only help you to optimise your performance but also help to protect and improve your health.

We've created this guide for you to use as a handy reference tool, to help you build your understanding of the role key biomarkers play in both your health and your performance. The biomarkers which we offer have been arranged in two ways – firstly by A-Z and then grouped by category, so you can quickly identify the role they play in your performance.

**A biomarker** = a biological indicator of your body's internal condition, usually measured in the blood.



## A-Z of biomarkers

### Albumin

#### Marker for: Injury Prevention + Health

Albumin is a protein which is made in the liver. It has many roles including transporting key molecules such as calcium. The amount of albumin in the blood is directly associated with liver function and nutritional health. As albumin transports calcium, it is also used as a marker in the assessment of bone health.

### ALT & AST

#### Marker for: Recovery + Health

ALT & AST are enzymes mostly found in the liver, with only small amounts found in the blood. ALT & AST levels rise in response to liver or muscle damage, so can be used as markers for both health or recovery following intense exercise. Raised levels caused by muscle damage can take 1-2 weeks to recover depending on the athlete.

### Calcium

#### Marker for: Injury Prevention

Calcium is essential for building strong bones. It is important for athletes to maintain calcium levels within the normal range to decrease the risk of stress fractures and other bone injuries. Good sources of calcium include milk, cheese and green leafy vegetables such as broccoli and cabbage.

## Chloride

### Marker for: Hydration

Chloride and sodium exist bound to each other and can be dangerous if low. Chloride is an important mineral and helps to maintain the body's pH balance by regulating the amount of fluid inside and outside of cells. It also plays a role in digestion as well as helping to maintain blood pressure and blood volume.

Chloride and sodium are lost from the body through sweat. It is therefore important that athletes who participate in endurance sport, or sweat heavily during workouts, rehydrate with isotonic drinks rather than just water alone. This helps to replace lost chloride and sodium and restore the body's pH balance.

## Cortisol

### Marker for: Training Load + Recovery

Cortisol is a steroid hormone produced by the adrenal gland and released in response to stress. It is normal for levels of cortisol in athletes to rise in response to hard training. It can also rise before a race in response to psychological stress.

Measuring cortisol is useful in assessing your body's ability to respond to stress. This marker can be used to establish recovery patterns as well as identifying if you are at risk of over-training. Over-training for a short period of time will increase cortisol, but persistent over-training will lead to a fall in cortisol due to adrenal burnout. This can lead to fatigue, muscle weakness, poor sleep, lack of motivation, irritability and increased illness.

## C-Reactive Protein

### Marker for: Training Load + Recovery + Health

C-reactive protein (CRP) is a marker of acute inflammation. It can therefore be raised in response to various inflammatory conditions including infection (especially bacterial) and exercise. CRP will rise dramatically 2-3 days post intensive exercise and can be up to 10 times greater. It should then return to normal during recovery.

The measurement of CRP is therefore helpful in establishing recovery patterns. Alongside cortisol, it is also a useful indicator of over-training if levels do not return to baseline following a recovery period.

## Creatinine

### Marker for: Recovery + Health

Creatinine is a waste product produced by muscles which is removed from the body by the kidneys. The level of creatinine your body produces will vary according to body size and muscle mass. As creatinine is removed from the body by the kidneys it is used as an indication of how well the kidneys are functioning. Following extreme exercise that causes muscle damage, creatinine levels can increase above baseline. Assuming normal renal function this should quickly return to normal levels.

## Creatine Kinase

### Marker for: Recovery + Training Load

Creatine kinase (CK) plays an important role in muscle contraction and energy production. CK leaks into the blood after repeated and intense muscle contraction. Athletes who participate in regular training often have naturally higher levels of CK which will gradually decrease during a recovery period, enabling the athlete to measure recovery time. Failure to return to a normal level during recovery can indicate over-training.

## eGRF

### Marker for: Recovery + Health

eGRF is a calculation based on your creatinine levels which measures the filtration rate of your kidneys. This is used to evaluate how well your kidneys are working. As eGFR is related to creatinine, levels will be affected by the high levels of creatinine you can get following extremes of exercise. This should then return to baseline alongside creatinine.

## Ferritin

### Marker for: Training Load + Fatigue

Ferritin is the main form by which iron is stored in the body and the best marker of iron deficiency. If your iron levels have decreased, ferritin will be the first indicator. Rates of iron deficiency are known to be higher in athletes. Evidence suggests this is due to increased loss through muscle damage and the body's partial block on iron absorption during intensive exercise. For athletes, levels of ferritin should be kept within the upper end of the normal range to prevent fatigue.

However, a result which indicates normal levels of ferritin does not always rule out iron deficiency. This is because ferritin also rises in response to inflammation and can stay raised for several days following intense exercise. Consistently high levels can therefore also be used as an indicator of over-training.



## Folate

### Marker for: Fatigue

Folate, otherwise known as folic acid plays an important role in the formation of new healthy red blood cells, as well as the repair of tissues. If you don't have enough red blood cells, a lower level of oxygen will be delivered to your muscles, resulting in a decrease in energy and your muscle tissue will take longer to repair. Folate is closely linked to Vitamin B12 as well as iron, all of which need to be kept in the normal range to prevent the different forms of anaemia which can result in you feeling tired and weak.

## Follicle Stimulating Hormone (FSH)

### Marker for: Injury Prevention + Health

Follicle stimulating hormone (FSH) and luteinising hormone (LH) play an important role in the reproductive system in both men and women, as well as having an influence on bone density. FSH (along with LH) can become suppressed in endurance athletes where energy output may exceed dietary intake. This leads to a decrease in oestradiol which in turn can lead to a decrease in bone density, increasing the risk of injury.

## Free Androgen Index (FAI)

### Marker for: Health

Free androgen index (FAI) is an estimate of the amount of available testosterone in the bloodstream i.e. the portion of testosterone which is biologically active. Low levels of testosterone in men can lead to reductions in energy and motivation to train, as well as poor libido.

## Haematocrit

### Marker for: Fatigue

A haematocrit test measures the ratio of red blood cells in the blood and is an indicator of oxygen carrying capacity. Low levels means less oxygen is being carried to your tissues which can result in a loss of energy and lead to anaemia. In athletes, haematocrit levels may appear to reduce which can sometimes be due to an increase in the body's blood volume levels increasing, rather than as a result of anaemia.

## Haemoglobin

### Marker for: Fatigue

The primary role of haemoglobin is to carry oxygen to cells throughout the body and return carbon dioxide back to the lungs. Haemoglobin is therefore essential to athletic performance. By improving your level of haemoglobin, you can improve your organ and tissue functions and increase your overall energy levels.

Low levels of haemoglobin can indicate anaemia which will result in reduced energy. High haemoglobin levels are indicative of too many red cells which can be due to several reasons including dehydration. The main nutrient to optimise all red blood cells is iron.

## Iron

### Marker for: Fatigue

Iron is essential for the production of haemoglobin within red blood cells. Athletes have a higher risk of iron deficiency so it is important to ensure your levels remain in the normal range to avoid fatigue. Prolonged iron deficiency can lead to anaemia. The best source of iron is red meat, while the iron content within plant sources can be harder for the body to absorb. Too much iron can also be detrimental to your health.



## Luteinising Hormone (LH)

### Marker for: Injury Prevention + Health

Luteinising hormone (LH) and follicle stimulating hormone (FSH) play an important role in the reproductive system in both men and women, as well as having an influence on bone density. Luteinising hormone (along with FSH) can become suppressed in endurance athletes where energy output may exceed dietary intake. This leads to a decrease in oestradiol which in turn can lead to a decrease in bone density, increasing the risk of injury.

## MCH

### Marker for: Fatigue

MCH stands for mean cell haemoglobin and is a calculation of the average amount of haemoglobin within red blood cells. Haemoglobin is responsible for carrying oxygen from the lungs to the cells throughout the body. This marker is measured as part of a complete blood count and can indicate if the body is suffering from a form of anaemia which leads to fatigue. High levels of MCH can sometimes be a sign of anaemia caused by folate deficiency whilst low levels of MCH are associated with iron deficiency anaemia. In athletes, MCH levels can rise naturally as the body's blood volume level increases in response to exercise.

## MCV

### Marker for: Fatigue

MCV (mean corpuscular volume) is a measurement of the average size of your red blood cells, which are integral to carrying oxygen around the body. Similar to MCH, this marker can help to identify anaemia and its cause. For example, high levels of MCV can sometimes be a sign of anaemia caused by folate deficiency whilst low levels of MCV are associated with iron deficiency anaemia. In athletes, MCV levels can rise naturally as the body's blood volume level increases in response to exercise.



## Oestradiol

### Marker for: Injury Prevention + Health

Oestradiol is more commonly known for its role in male sexual function and in maintaining the female reproductive system. However, it also plays an important role in bone density. In endurance sports, oestradiol can be decreased due to low LH and FSH, causing a reduction in bone density and an increase in the risk of injury such as stress fractures. From a health perspective, low levels of oestradiol can also cause mood swings and fatigue and well as problems with fertility.

## Sex Hormone Binding Globulin

### Marker for: Health

Sex hormone binding globulin (SHBG) is a protein which attaches itself to testosterone and controls how much is available to your body tissue. It is measured alongside testosterone and the results are used to calculate the amount of testosterone which is biologically active within the body. This estimate is known as free androgen index.

## Sodium:

### Marker for: Hydration

Sodium and chloride are electrolytes which exist bound to each other within the body. Each plays a significant role in regulating the body's water balance as well as helping to maintain blood pressure. Low sodium levels can be dangerous and often results after intense exercise when sodium is lost through heavy sweating. Rather than drinking water alone it is therefore important to drink isotonic drinks to replace the lost sodium, or by simply adding a small amount of salt to squash or water.

## Testosterone

### Marker for: Health

Testosterone is a steroid hormone largely produced in males, however women also produce a small amount. Low levels in men can lead to reductions in energy and motivation to train as well as poor libido. High levels in women can often be caused by a condition known as Polycystic Ovary Syndrome. The use of steroids can cause a decrease in the level of testosterone in men.

## Total Iron Binding Capacity

### Marker for: Fatigue

Total iron binding capacity (TIBC) results are usually viewed alongside iron and ferritin measurements and reflect the amount of iron in the body. Typically, TIBC levels will be high and iron levels low if you are iron deficient. Conversely your TIBC level will be low and your iron level high if you have too much iron.

## Transferrin Saturation

### Marker for: Fatigue

Transferrin saturation is calculated using the results from iron and TIBC. Transferrin saturation is usually low in cases of iron deficiency and high if the body had too much iron.

## Thyroid Stimulating Hormone

### Marker for: Fatigue + Health

Thyroid stimulating hormone (TSH) plays an important role in regulating the production of hormones by the thyroid gland, which controls your metabolism and regulates the speed at which your body converts fuel to energy. 1 in 20 people living in the UK are affected by thyroid disorders. If you have an over-active thyroid, your body's metabolism will speed up often leading to burn out, whilst those suffering from an under-active thyroid have too little thyroid hormone resulting in a lack of energy and weight gain.



## Urea

### Marker for: Health + Hydration

Urea is a waste product which is formed in the liver when protein is metabolised and is removed by the kidneys. It is therefore a good indicator of whether your kidneys are functioning properly. Urea may increase 2-3 days following intense exercise due to muscle breakdown. Dehydration can also cause it to increase.

## Vitamin B12

### Marker for: Fatigue

Vitamin B12 (along with folate) are both part of the B group of complex vitamins. B12 is required for the formation of red blood cells. Low levels can lead to a decrease in red blood cell production and therefore a reduction in oxygen delivery to the body's tissues. A deficiency in B12 can ultimately lead to anaemia, a condition which will leave you feeling tired and weak. Vitamin B12 is not created by the body so needs to be absorbed through your diet.

## Vitamin D

### Marker for: Fatigue + Injury Prevention

Vitamin D plays an essential role in health including energy production and bone growth to name but a few. It is estimated that over 50% of the UK population are deficient in this vital vitamin due to limited exposure to sunlight. Low levels increase the risk of bone injuries such as stress fractures which can have a huge impact on athletic performance. Low levels can also lead to reduced energy, increased inflammation and weaker immune function.

## White Blood Cell Count

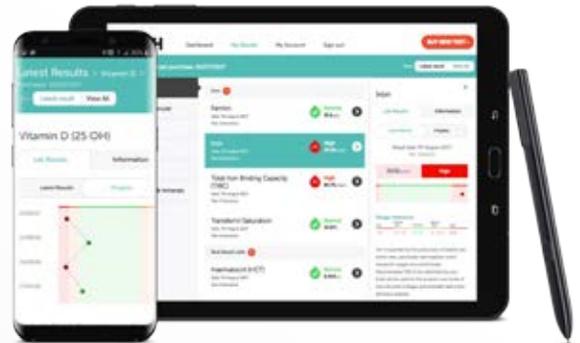
### Marker for: Training Load + Health

White blood cell (WBC) count is a measurement of the number of white blood cells in your body. WBCs are an important part of the body's immune system and help to protect it against illness. Higher levels are common if your body is trying to fight off an illness, or at times of physical stress either through injury or intensive training. A low WBC count indicates a weakness in your immune system making you more susceptible to illness. This can be caused by prolonged over-training.

## Zinc

### Marker for: Fatigue + Injury Prevention

Zinc is an essential trace element and is important for energy as well as wound healing, new cell growth and the processing of carbohydrates, fat and protein. The best source of zinc is red meat but it can also be found in poultry, fish, dairy and whole grains.



# Biomarkers by category



## Fatigue

Ferritin

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Folate

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Haematocrit

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Haemoglobin

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Iron

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MCV

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MCH

---

Total Iron Binding Capacity

---

Transferrin Saturation

---

Thyroid Stimulating Hormone (TSH)

---

Vitamin B12

---

Vitamin D

---

Zinc



## Health

Albumin

---

ALT

---

AST

---

C-Reactive Protein

Creatinine

---

eGRF

---

Follicle Stimulating Hormone (FSH)

---

Free Androgen Index (FAI)

---

Luteinising Hormone (LH)

---

Oestradiol

---

Sex Hormone Binding Globulin (SHBG)

---

Testosterone

---

Thyroid Stimulating Hormone (TSH)

---

Urea

---

White Blood Cell Count (WBC)



## Hydration

Chloride

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Sodium

---

Urea





## Injury Prevention

Albumin

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Calcium

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Follicle Stimulating Hormone (FSH)

---

Luteinising Hormone (LH)

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Oestradiol

---

Vitamin D

---

Zinc



## Recovery

ALT

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AST

---

Cortisol

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C-Reactive Protein

---

Creatinine

---

Creatine Kinase

---

eGRF

Creatinine

---

eGRF

---

Follicle Stimulating Hormone (FSH)

---

Free Androgen Index (FAI)

---

Luteinising Hormone (LH)

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Oestradiol

---

Sex Hormone Binding Globulin (SHBG)

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Testosterone

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TSH

---

Urea

---

WBC



## Training Load

Cortisol

---

C-Reactive Protein

---

Creatine Kinase

---

Ferritin

---

WBC

# FORTH EDGE<sup>®</sup>



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by tracking your biomarkers

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