

Food and performance

Energy balance

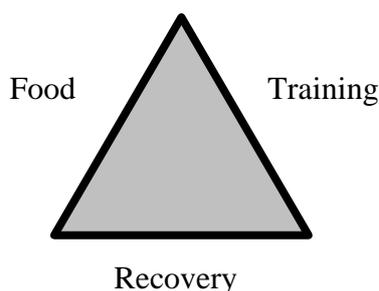
Orienteers have a high-energy requirement as they continually work their bodies hard, both in training and competition. It is very important that our diet, the fuel and building material for our body, is of a high quality.

In orienteering both aerobic and anaerobic metabolism contribute to energy production in the muscles. The size of the muscle and liver glycogen reserves is therefore extremely important so that the brain can be supplied with blood sugar and make the right decisions while the body continues to work at a high intensity. Large amounts of carbohydrate in our diet before training and competition are therefore absolutely essential.

The intensity of our training is the main factor that determines energy expenditure. The more intensively we train the more energy is taken from the glycogen reserves, while at lower intensities both fat and glycogen are used as fuel. The energy turnover during an hour of training lies between 1000-1500 kcal. The factors that determine how much energy is used are the training intensity, sex, age and weight. As general rules the following are true: High intensity requires more energy than low intensity training, men require more than women - men have more muscle mass, young people (15-25 years old) require more energy than older people and people with a higher body weight require more energy than those with lower body weight.

How much energy an orienteer requires is in other words totally individual. For this reason advice on nutrition for orienteers must start with the individual. What is sensible for one person can be totally crazy for another. But to give a basic idea, for a competitive junior or senior 4000 kcal for women and 5000 kcal for men are reasonable daily figures. However, how we train and what we do with the rest of the time during the day are crucial factors in the energy balance equation. It is important when giving nutrition advice for sport to consider how different the requirements of an active sports person can be from the average man on the street. The most important thing to remember is that we should always start with the individual.

Many people train hard to try to improve their performance. Technique must be continually polished and the right muscles developed. But to get the most benefit out of this training there must be a suitable balance between three crucial components: food, rest and training. When the energy in our food is less than that we use during training and competition, there is no energy left to build new muscles or for recovery. Training becomes wearing and breaks the body down instead of encouraging development.



A simple rule to follow is that food and recovery must also be increased when we increase training volume. The right balance between these three factors can be compared with an equilateral triangle. If one side of the triangle is changed then

the other two must follow if the triangle is to remain balanced (see diagram).

Food groups

The food we eat consists of carbohydrates, fat, proteins, vitamins, minerals and water. Carbohydrate, fat and protein are energy sources while vitamins, minerals and water have other important jobs such as protecting the body against infection.

Protein

Protein is the body's most important building material. Muscles and other tissues need protein to build up and repair the body. Protein consists of around 20 different amino acids, which are formed into different chains, with different appearances. Eight of these are essential and cannot be synthesized by the body. If we eat a balanced diet we will get the protein that the body requires without problems. Protein should count for 10-15 percent of our total energy intake, which means that if we are in energy balance a well-trained orienteer will easily meet her requirement for protein.

The following foods contain the proteins we need:

Animal based products:

- Meat
- Fish
- Poultry
- Eggs
- Milk products

Combinations of vegetable products:

- Corn + peas
- Lentils + bread
- Corn/rice + beans

Fat

Fat is a food group with many important roles. Unfortunately fat does not enjoy good press among sportspeople or the general public. Yet fat is a very important part of an orienteer's diet, as it is indeed for all endurance athletes and especially for women. Fat is a large source of energy for all types of activity. The lower the intensity, the more energy is taken from the "fat tank". Fat works as a support for the inner organs and helps to keep body temperature constant. Fat also provides energy for the hormone system, surrounds each nerve fibre as an insulation material, like an electrical cable and is present as a building material in cell membranes. We get several important fatty acids and the fat-soluble vitamins A, D, E and K through the fat in our diet.

As there is a strong link between the female hormone oestrogen and percentage body fat for women, menstruation is a signal of whether there is balance between food, training and recovery. If menstruation ceases or is irregular then a woman has too little fat in the body and is unable to produce oestrogen. This leads to serious problems with calcium absorption, which is essential for maintaining the bones. Too little fat can actually lead to low bone density or eventual osteoporosis and there is a greatly increased risk for injuries such as stress fractures.

Fat should make up about 25-30 percent of our total daily energy intake, but for an orienteer who has an extremely high energy requirement it is sensible to lie on the upper limit, and

indeed perhaps a bit over, 35 percent, so that the food we eat is not so bulky. If we compare fat with carbohydrate, it provides the same energy in half the volume, which is perfect for a sportsperson who requires a lot of energy. If food contains some fat, less food is needed than if we only to eat carbohydrate based food.

Fat is present in the following foods:

- Dairy products
- Vegetable oils, margarine
- Fatty fish: Salmon, mackerel, herring
- Mayonnaise
- Nuts

Carbohydrate

Carbohydrates are the body's primary source of energy during training and competition. Carbohydrate is the chemical name for the food group consisting of sugars, starch and dietary fibre. Carbohydrate is stored in the muscles and liver in the form of glycogen reserves and is also in the blood in the form of blood sugar. When the body requires energy, glycogen is broken down into glucose. A simple way of looking at the process is that muscle glycogen is used for muscle work and blood sugar is the fuel for mental work.

The main part of our diet should consist of carbohydrates – about 55-65 percent of the total energy requirement. This requirement can also be calculated as an amount per kilogram of body weight per day. Suitable amounts range from 6 to 10 grams per kilogram per day. The upper limit would be suitable for someone training twice a day.

Carbohydrates can be found in the following foods:

- Pasta, rice, potatoes
- Bread
- Oats, porridge, muesli
- Fruit
- Vegetables and root vegetables

Glycaemic Index - Slow and fast carbohydrates

Certain carbohydrates are broken down more quickly than others and are taken more quickly into the blood stream. Carbohydrates that are broken down slowly are said to have a low glycaemic index and those that are broken down quickly have a high glycaemic index. The rate of breakdown depends on fibre content, carbohydrate structure and chemical makeup and the amount and type of cooking the food has undergone.

A high intake of just fast carbohydrates with a high glycaemic index will give a rapid rise in blood sugar levels, which can lead to a significant insulin reaction. Insulin is responsible for transporting glucose from the blood vessels into the cells. The result can be that you will feel hungry and tired again shortly after this type of food. Slower carbohydrates with a lower glycaemic index will give a slower rise in blood sugar levels and a more even insulin reaction.

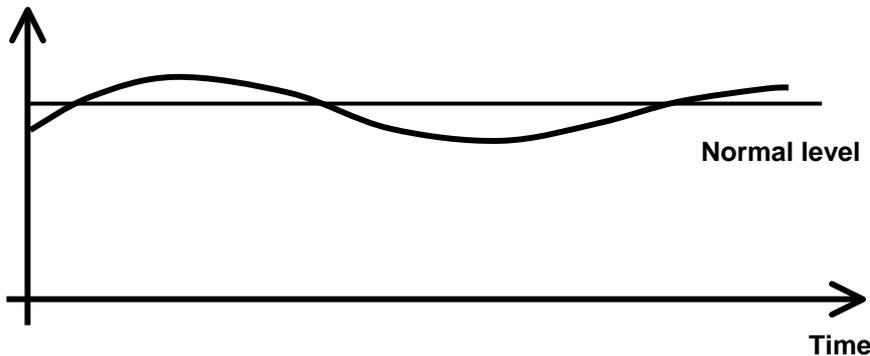
Somewhat simplified, we should eat slow carbohydrates before training and competition, while during and directly after we should eat fast carbohydrates, and then slow carbohydrates again some hours after. During training and competition insulin is not activated in the same

way, in fact the muscle cells stand more or less wide open for carbohydrate metabolism and storage.

If we on the other hand only eat fast carbohydrates during the day when we are working or studying there is a risk that the blood sugar will rise and fall in a series of peaks and troughs and we will feel energetic for a while before becoming rapidly tired and losing concentration (see diagrams).

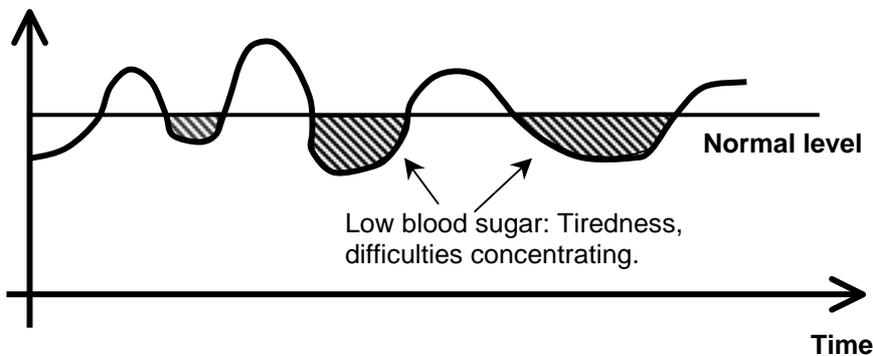
Slow carbohydrates give a slow and controlled rise in blood sugar.

Blood sugar level



Fast carbohydrate foods can lead to peaks and troughs in blood sugar levels.

Blood sugar level



Examples of slow carbohydrates

- Couscous
- Baked beans
- Split peas and other pulses
- Lentils Pasta, fluffy rice (lightly cooked)
- Wholegrain bread
- Milk, yoghurt
- Apple, banana
- Juice

Examples of fast carbohydrates

- Puffed rice
- Cornflakes
- Sports drinks
- White bread
- Brown bread
- Porridge
- Sticky rice (well cooked)
- Potatoes

Energy reserves in the body

Energy in the body

| | |
|---------------|----------------------------------|
| Liver | 50-100 grams (liver glycogen) |
| Muscle | 350-1000 grams (muscle glycogen) |
| Fat | > 10 000 grams |
| Blood glucose | 5 gram |

| <i>Competition duration</i> | <i>Percent of VO₂ max</i> | <i>Energy requirement for that pace</i> |
|-----------------------------|--------------------------------------|---|
| < 1 min | >> 100 percent | > 15 g/min (muscle glycogen) |
| 1-5 | > 100 | ≈ 10 |
| 6-15 | ≈ 100 | ≈ 7 |
| 16-60 | 98-94 | ≈ 6 |
| 61-120 | ≈ 90 | ≈ 5 |
| > 120 | 89-75 | ≈ 4 |

For an orienteer this means that the “fuel tank” in the muscles that are used for running, the legs, may be nearly empty after 75-80 minutes running. It is therefore important to consider how we can fill this tank before, during and directly after training and competition.

Vitamins and minerals

Several vitamins and minerals are referred to as antioxidants due to their capability to mop up so called free radicals in the body. Free radicals are very unstable, highly reactive elements and compounds that, among other routes, are sometimes formed naturally in the body during aerobic metabolism. Free radicals can, if we are not protected from them, damage cells by oxidising fatty acids in the cell walls, which can lead to illness. During periods of hard training, such as training camps or when competing in multi day competitions or the big Scandinavian relays where you may have to run through the night, the production of free radicals will increase. In these cases antioxidants may be particularly important.

In other words, it is important to eat a balanced and varied diet and make sure that the food contains products rich in antioxidants such as vitamin C, E, A and selenium.

Vitamins have an important role in controlling several processes in the body. They are essential and we need to eat them daily. An orienteer has a high energy requirement and therefore needs a lot of food. If we eat a varied and balanced diet during the day we will get the vitamins that we need. It is not necessary to supplement this with countless different vitamin pills. In certain extreme cases during very hard training, or when visiting countries where food is a limiting factor it can be useful to take vitamin supplements, but not otherwise.

Vitamins can either be fat or water-soluble. Vitamin A, D, E, and K are fat soluble while vitamin B and C are water-soluble.

Fat-soluble vitamins

Vitamin A is important for vision in the dark, the skin, mucous membranes, growth and resistance to illnesses and infections. Vitamin A is present in liver, milk products, margarine, cheese, fatty fish, carrots, peppers, and apricots.

Vitamin D regulates the calcium balance in the skeleton and teeth which means that it is important in ensuring that enough calcium is absorbed. Vitamin D is found in fatty fish, egg yolks, milk products and margarine and is also synthesised in the skin when we are exposed to sunlight.

Vitamin E protects vitamin A and the unsaturated fatty acids against oxidation. Vitamin E is thought to contribute to the stability of the cell membrane by protecting the polyunsaturated fatty acids in the membrane from attack by free radicals and oxidation. Vitamin E is found in cereals, especially in wheat germ, margarine, oils, fish, almonds, nuts, beans, liver, eggs, vegetables and root vegetables.

Vitamin K is necessary for blood coagulation and is also important for nerves, muscles protein and energy metabolism, the liver and the formation of blood. About half of our vitamin K requirement comes from food; the rest is produced by bacteria in the intestine. Vitamin K is found in vegetables such as broccoli, spinach, sprouts and also in kidney and liver.

Water-soluble vitamins

Vitamin B exists in different forms: B1, B2, B6 and B12. Vitamin B is necessary to convert carbohydrate, protein and fat into energy. They are also necessary for muscle and nerve function. Vitamin B deficiency affects several metabolic processes and leads to an increase in pyruvate and lactic acid in the blood among other problems. Vitamin B is also important in the formation of red blood cells. Orienteering is essentially an endurance sport where athletes work both aerobically and anaerobically. This means that our requirement for vitamin B is greater as our glycogen stores must be broken down and converted to energy. Vitamin B is found in flour, oats, bread, pasta, wheat germ, potatoes, meat, fish, chicken, shellfish, vegetables, fruit and milk products.

Vitamin C is necessary for the formation of connective tissues in the skin, blood vessels, skeleton and the teeth. It is also beneficial for healing of cuts and bruises and protects vitamin A and E and fatty acids against oxidation. Vitamin C is found in fruit and berries, citrus juices, vegetables, potatoes and root vegetables. It is beneficial to include a food or drink rich in vitamin C at mealtimes as this helps the body to absorb iron from food.

Minerals

Minerals account for only 5 percent of our body weight but are very important for both structure and function. Approximately 2 percent of the bodies weight is calcium and most of this is found in the bones. Other elements include phosphorous, potassium, sulphur, sodium, chlorine and magnesium in decreasing order, all the way down to the small amounts of iron, selenium, fluoride and zinc, which nevertheless have an important role to play, regulating the many chemical reactions that take place inside our bodies.

If we eat a well balanced and varied diet we will get enough of all the minerals we need. As far as sport and particularly endurance sports are concerned, however, iron and calcium can

be exceptions. Women who train very hard sometimes have difficulties in meeting their iron requirements. Iron is often in the food we eat but our ability to absorb it depends on the other foods that make up the meal. Vegetarians should also be observant as most of our selenium requirement comes from animal products.

Iron

Iron is found in the haemoglobin in red blood cells, in the myoglobin in the muscles and in iron-dependant enzymes. Iron deficiency, can lead to reduced resistance to infection and anaemia, which leads to reduced performance. One of the important jobs iron has in the body is to transport oxygen from the lungs to the working muscle cells. Iron deficiency can give a low Hb value which means that we have a reduced capacity to transport oxygen. High Hb values indicate a higher capacity for oxygen transportation and this is naturally a very important physiological factor for an elite orienteer.

Iron is found in abundance in animal products such as meat, liver and fish but also occurs in non-organic form in fruit, beans, bread, oats and pasta.

Absorption of iron is significantly affected by the food and drink served with the iron rich food. Foods rich in vitamin C such as fruit, berries, juice and vegetables encourage iron absorption. Caffeine in tea and coffee, and milk chocolate, significantly reduces iron uptake.

Calcium

Calcium is found in our bones, soft tissues and in bodily fluids. Calcium is very important for the bone formation and for muscle contractions. Calcium deficiency can lead to low bone density and osteoporosis. If this happens before puberty or during puberty then the spine and pelvis are worst affected. The bones in the limbs will be affected if this process takes place later. According to current research we can store calcium and build up the skeleton until we are 25 or perhaps 30 years old. After this, the storage process declines and our bones become weaker with age. It is therefore very important to ensure that we have strong bones during our younger years, both for our sporting career and for our later years.

Milk and cheese are the best calcium sources, without these products it is difficult to meet our calcium requirements. Calcium is also found in broccoli, cauliflower, sardines, mussels, prawns, and eggs.

Selenium

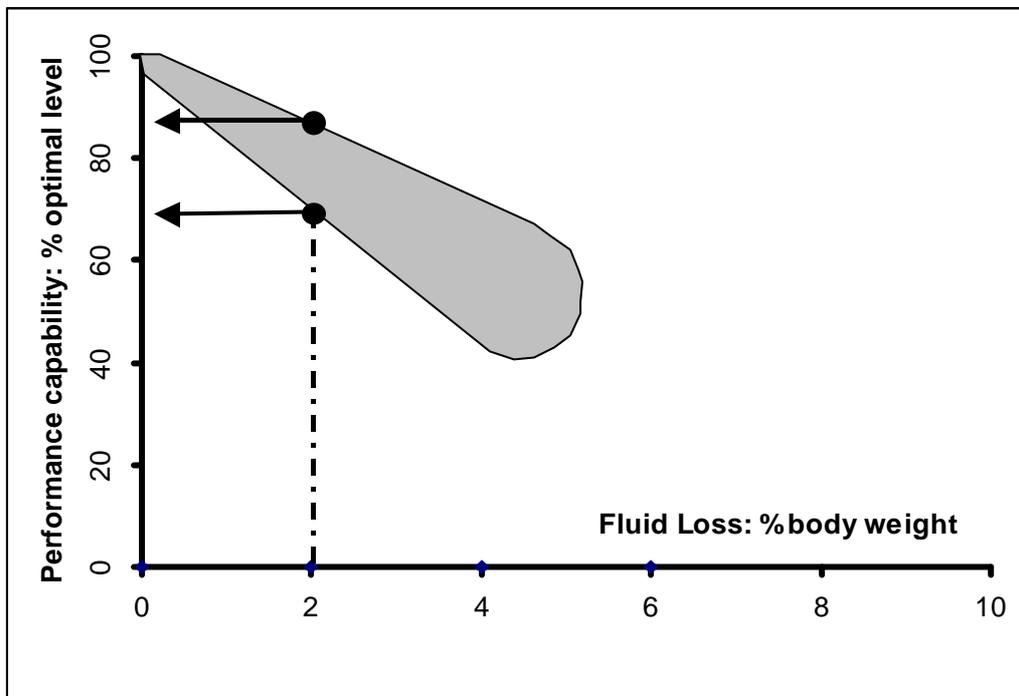
Selenium is a trace element which helps prevent cell damage. It protects the body together with vitamin E by mopping up free radicals. Hard training and poor recovery leads to an increase in free radicals in the body. Selenium is mainly found in animal products such as fish, meat and milk products.

Water

Water is an essential substance for life. Fluid turnover in normal climatic conditions is around 3 litres per day. When humidity is higher, as it was at the 1996 summer Olympics in Atlanta for example, a turnover of 6-8 litres is normal. About half of our fluid requirement comes from what we drink and the rest comes from water in our food. About 60 percent of our body weight is water. Men have more than women, due to their greater muscle mass. Water is found in and outside all the cells of the body, but also in the various body cavities. It can pass freely through all our tissues and cell walls. Water equalizes differences in salt content

between different tissues in the body and keeps our salt levels in balance in this way. Water also helps to clear away waste products which are formed during different metabolic processes. Correct fluid balance is easy to check daily. Urine should be colourless or light yellow in appearance: If it is darker, drink more water!

When training and competing or carrying out other physical activities we lose a lot of water. Increased metabolism to provide energy for the work results in heat production and to prevent overheating we begin to sweat. Fluid lost through sweating must be replaced. If we lose as little as 2 percent of our body weight, or about 1.4 litres for a person who weighs 70 kg, performance is reduced to 80-85 percent of optimum. Fluid reserves must be filled before training and competition and kept topped up during activity. During training and competition it is recommended that you drink 200-250 ml every 15-20 minutes. If the session is less than 45 minutes long water is suitable. When training or competing for a longer time you should drink a weak carbohydrate mixture, such as a sports drink.



After training and competition it is important to restore energy and fluid balance in the body. Suitable foods include bananas, white bread, raisins and sugary sweets such as Jelly Babies. Drinks such as water, sports drink, squash or juice are suitable. It is easiest to replenish the glycogen stores directly after hard activity. Recovery will be considerably quicker if you remember this.

Mealtimes

In order for training to be effective we should plan for breakfast, lunch, dinner and 1-2 snacks. Meals do not necessarily need to come in this order. For example, if training is in the early evening when you would have eaten dinner, you could have a light supper before, then take a proper meal for dinner afterwards. The important thing to remember is that there must be a balance between “energy in” and “energy out” – eat enough to cover your energy requirements. Meals should be at times that fit in with your routine.

A simple rule of thumb can help to eat appropriate amounts of different food groups. A good meal for an orienteer who has high-energy requirements might be as follows:

- ½ plate of potatoes, rice or pasta
- ¼ plate of root vegetables and vegetables
- ¼ with meat, fish, chicken or egg

Bread is a good addition to the meal, with or without a spread. Milk or another similar drink is ideal and you can finish with a simple pudding such as fruit or berries. If you need more energy it is easy to increase the size or number of portions and add snacks in between meals. When you are training at your absolute hardest it is probably easiest and best to increase the potato or pasta portion in the main meal and perhaps add a little sauce to make the food moister and creamier.