

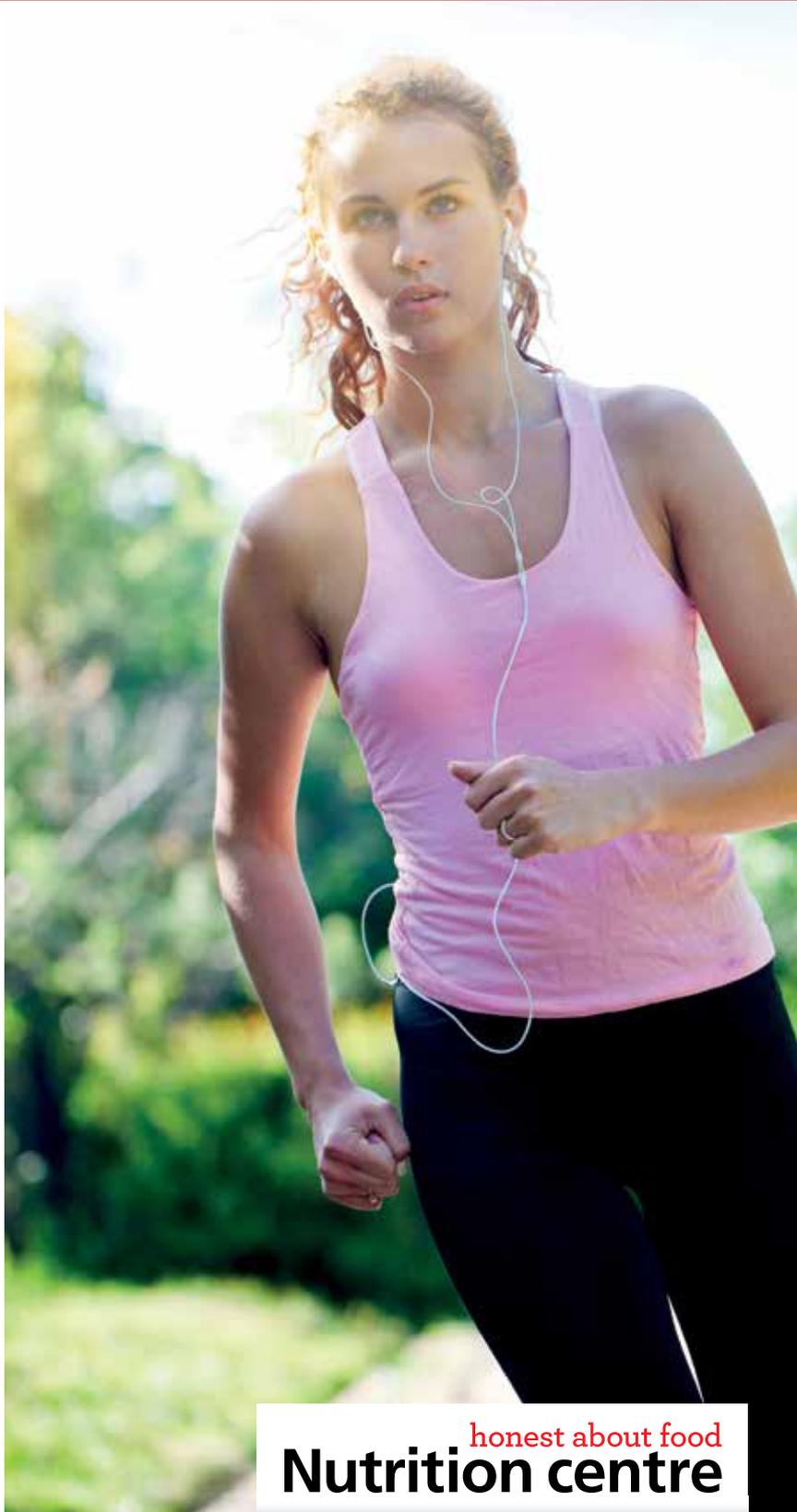
Sports and nutrition

Fact sheet

Sufficient exercise and healthy eating habits can both reduce the risk of chronic disease. Combine the two and you will reap the greatest health benefits. A healthy diet will supply all the nutrients and energy you need to exert yourself. Recreational athletes who eat in accordance with the Wheel of Five will ingest sufficient energy and nutrients. They do not need to take vitamin and mineral supplements. It should also be noted here that not all supplements are safe for ingestion.

This fact sheet was developed in association with the Knowledge Centre for Sport Netherlands. The fact sheet discusses several subjects related to nutrition for athletes, such as striking a proper balance between nutrition and exercise, the Physical Activity Guidelines (revised in 2017), the role of carbohydrates, fats and proteins in endurance and strength sports and information on sports nutrition products and how they may enhance an athlete's performance and post-workout recovery.

Healthy eating habits are at the basis of a solid athletic performance, regardless of the athlete's skill level. Could the athlete's dietary habits be improved? If so, we recommend eating a proper diet before investing in protein shakes, sports gels, protein bars, vitamin and mineral supplements and other sports nutrition products. A well-balanced diet as outlined in the Wheel of Five contains more useful ingredients than a supplement. In other words, recreational athletes who eat in accordance with the Wheel of Five do not need to take any supplements.



For whom is it relevant?

This fact sheet allows coaches, dieticians and other people working in the sports industry to provide their clients with up-to-date information on nutrition for recreational athletes. The recommendations made in this fact sheet apply to adult recreational athletes. There are various reasons for recreational athletes to exercise. For instance, they may exercise because of the health benefits, to relax, to lose some weight, or to achieve a personal goal, such as running a marathon or increasing their muscle mass. Naturally, every athlete is welcome to seek advice on nutrition and exercise from a sports nutritionist. We particularly recommend a sports nutritionist for athletes seeking to excel at their chosen sports.

What issues are involved?

A great deal of information on the relationship between nutrition and sport can be found on the Internet. However, the information found online is not always based on scientific evidence. We hope this fact sheet will shed some light on current scientific understanding of certain subjects.

What science tells us

Sufficient exercise and healthy eating habits both help reduce the risk of overweight and chronic disease, such as cardiovascular disease and type 2 diabetes.¹⁻² A healthy diet and a healthy dose of physical activity may also make the treatment of such conditions more effective.³ Moreover, getting (more) exercise has a positive effect on a person's emotional well-being, social development, self-assertiveness and self-esteem, and playing sports and getting (more) exercise reduce the risk of symptoms of depression.⁴⁻⁵

My Nutrition Centre

People can create personal profiles at www.mijnvoedingscentrum.nl. This website presents three useful tools: the Daily Calorie Intake Meter, My Exercise and the BMI Measurement Tool. These allow you to keep track of your diet, exercise pattern and weight. The Daily Calorie Intake Meter is also available as an app.



A healthy basis for everyone

Everyone, including recreational athletes, can ensure a healthy basis by following the recommended Physical Activity Guidelines 2017 and by eating in accordance with the Wheel of Five.

A healthy diet: the Wheel of Five

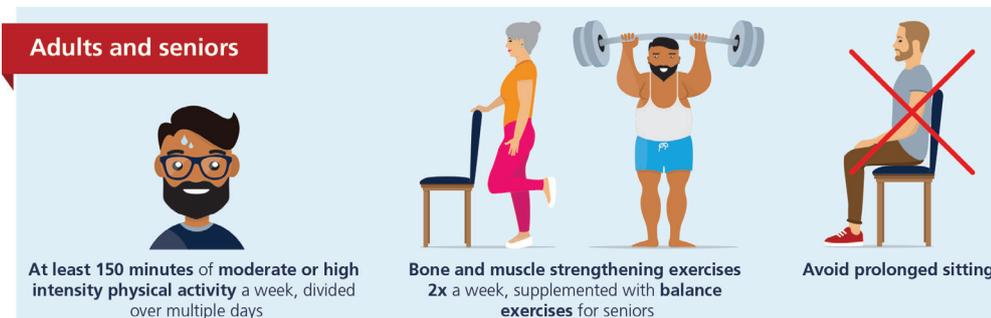
The Wheel of Five is the information model issued by the Netherlands Nutrition Centre, based on the Dutch Dietary Guidelines and the Dietary Reference Intake guidelines issued by the Health Council of the Netherlands.⁶⁻⁷ Eating in accordance with the Wheel of Five ensures that your food intake contains the optimum combination of products that result in better health and provide enough energy, as well as all the necessary nutrients. The general recommendations with regard to the types of food presented in the Wheel of Five are as follows:

1. Eat the recommended daily amounts of vegetables, fruit, unsalted nuts, dairy, whole-grain products and soft or liquid cooking oils, butters and margarines.
2. Eat fish (preferably some type of fatty fish) once a week.
3. Eat legumes at least once a week.
4. Do not eat more than 500 grams of meat per week.
5. Drink tap water and green and black tea, and if you drink coffee, opt for filtered coffee.
6. Add as little sugar and salt to your meals and drinks as possible.
7. Limit the number of biscuits, sweets, sugary drinks and snacks you ingest.



For a healthy diet, 10%-25% of your total energy intake (i.e., energy percentage) will consist of protein, 40%-70% of your total energy intake will consist of carbohydrates and 20%-40% of your total energy intake will consist of fat. Women who have a sedentary job and get little exercise in their leisure time require approximately 2,000 kilocalories per day. Men in a similar situation require approximately 2,500 kilocalories per day. In order to determine what amounts of certain types of food are appropriate for you according to the Wheel of Five, complete the 'Wheel of Five for You' survey on www.voedingscentrum.nl/adh

Sufficient exercise: the Physical Activity Guidelines 2017⁸



Energy balance

Physical activity and food both affect your energy balance.⁹ If your energy intake exceeds your energy expenditure, your body will store the excess energy in the form of fat tissue, which will cause you to gain weight. If your energy expenditure exceeds your energy intake, you will lose weight. A combination of more exercise and a healthier diet will help you lose weight and maintain a healthy weight. Due to their high level of activity, ambitious athletes require more energy to maintain the same weight.⁹ By eating in accordance with the Wheel of Five, such athletes will be able to meet their bodies' increased demand for energy.

BMI

The Body Mass Index (BMI) is a value expressing a person's body weight in relation to height.¹⁰ The BMI provides an indication of the health risks associated with a person's body weight. When we determine a person's BMI, we do not take body composition types into account. As a result, a bodybuilder with high muscle mass may have a high BMI without being the slightest bit overweight. In such cases, a combination of measurements (e.g. body fat percentage measurement, skinfold test and waist measurement)¹⁰ may be more accurate. Determine your BMI at www.voedingscentrum.nl/bmi

Fluid balance

On average, adults require 1.5 to 2 litres of fluid per day, ingested in the form of drinks. The exact amount of fluid needed depends on a person's age, the outside temperature and the person's physical activity level, nutrition and health situation.⁹

Physiology

It is impossible for an athlete to perform well without a good regular diet. Nutrition provides us with, amongst others, carbohydrates, fats, proteins, vitamins, minerals and trace metals. These nutrients play a major part in the many physiological functions that are vital to our survival. Carbohydrates and fats are converted by the body during a process that delivers a major source of energy called adenosine triphosphate (ATP). Muscles use energy provided by ATP to contract. These muscle contractions may result in movement.¹¹

Carbohydrates

Carbohydrates are a major source of energy for the brain and muscles, among other body parts. They are stored in the liver and muscles in the form of glycogen. Carbohydrates can be found mainly in whole-wheat bread, whole-wheat pasta and potatoes. If we eat enough carbohydrates, we will store the required amount of glycogen. When we exercise, this glycogen stored in our bodies is converted into carbon dioxide and water or into lactic acid, during which process the necessary amount of ATP will be formed.¹¹

The importance of carbohydrates to endurance athletes: During a long workout, carbohydrates and fats are our main sources of energy. When a long and high-intensity workout threatens to deplete the glycogen stored in our liver and muscles, we will begin to feel exhausted. This is known as 'hitting a wall'. It can be prevented by ingesting sufficient carbohydrates before a workout and/or by eating or drinking some carbohydrates during a long, high-intensity workout.

The importance of carbohydrates to strength athletes: During a high-intensity workout lasting an hour or less, our bodies' glycogen stores will suffice and will not have to be replenished during the workout. For instance, a brief explosive exertion such as weight lifting will use up a small initial supply of energy (ATP store) in the muscles. When this small amount of energy stored in our muscles is about to be depleted after a few seconds, phosphocreatine will provide us with the energy required to complete the action.

After about thirty seconds, this energy store, too, will be largely depleted. If we then continue engaging in strenuous exercise, our glycogen levels will be depleted as well, and our bodies will start producing lactic acid. This is another way in which a great deal of energy can be generated in very little time. After a workout, we can replenish our glycogen stores by ingesting carbohydrates. We can do so by eating a few types of food from the Wheel of Five or a full meal based on the Wheel of Five.

Fats

Fats play various roles in our bodies and form a major source of energy when we exert ourselves mildly to moderately,¹² which is why it is important that athletes consume enough fat (20%-40% of our daily energy intake) on a daily basis.¹³ By eating in accordance with the Wheel of Five, athletes can ensure they consume sufficient good fats.

Proteins

Consuming proteins promotes the formation of muscle protein and slows down muscle atrophy.¹⁴ People who do not engage in much physical activity need about 0.8 gram of protein per kilo of their body weight to maintain their muscle mass. For an adult person weighing in at 70 kilos, this will be $(0.8 \times 70 =) 56$ grams of protein per day.⁶ In the Netherlands, both men and women consume sufficient protein if they stick to a regular diet.¹⁵ Since athletes consume more energy than people who do not exercise, athletes eat more, too, meaning they will automatically consume more protein on average. Therefore, most recreational athletes do not require additional protein.¹⁶ However, depending on the athlete's objectives, it may be practical and easy to ingest additional protein by taking protein supplements. It is vital, however, that athletes ensure that their regular diet meets all the requirements before reaching for protein supplements.

The importance of protein to endurance athletes: Relatively little research has been conducted on the effect of increased protein intake on endurance athletes' performance. It has not been demonstrated that increased protein intake improves an athlete's performance. Even so, it is important that recreational athletes engaging in endurance sport nevertheless ingest enough protein, since this may reduce muscle ache, improve post-workout recovery and prevent the loss of muscle tissue during a period of weight loss.^{13, 14, 17} If their diet is in line with the Wheel of Five, recreational athletes engaging in endurance sport will ingest enough protein to promote muscle recovery.

The importance of protein to strength athletes: Ambitious strength athletes who explicitly wish to increase their muscle mass are advised to ingest more protein. The amount of protein necessary depends on the athlete's objectives, but ranges from 1.2 to a maximum of 2 grams per kilo of body weight per day.¹⁷ For a male strength athlete weighing in at 70 kilos, this amounts to 84 to 140 grams of protein per day. Since adult men tend to get approximately 95 grams of protein per day from a regular diet,¹⁵ they can add more protein to their diet by eating in accordance with the Wheel of Five, e.g. by adding a

combination of additional quark or yoghurt to their diet, or a glass of milk, some chicken breast or tofu and a handful of nuts or beans. The consumption of about 20 grams of protein per meal, distributed evenly across the day, has a positive effect on muscle recovery and will increase muscle mass.¹¹ Use meals such as breakfast, lunch and dinner to add protein to your diet, and perhaps some small meals in between the main meals, as well. Ingesting more proteins than your body needs will not result in greater muscle mass.¹⁷ Excess proteins will be used as energy or will be stored in the body in the form of fat, which may result in undesired weight gain.¹⁸

Vegetarians and vegans

Plant-based proteins contain fewer essential amino acids than animal-based proteins. These essential amino acids are required for all sorts of bodily processes, including recovery and muscle growth. For this reason, vegetarians and vegans on average require 20% and 30% more protein, respectively, than people who do eat animal products.⁷ In addition, vegetarians and vegans (particularly the latter) should ensure that they consume different sources of protein. For instance, legumes do not contain all essential amino acids, but if you make sure you also ingest enough grain products when eating legumes, you will still ingest all the amino acids you need.

Fluid

Sufficient fluid intake and a proper fluid balance are prerequisites for a good athletic performance.¹⁹ In order to get rid of the heat we generate when exerting ourselves and in order to prevent a further increase in our body temperature, we sweat. The evaporation of our sweat allows us to maintain our normal body temperature. As a result, athletes engaged in high-intensity workouts may lose up to two litres of fluid per hour. The exact amount of fluid lost depends on the person and on the duration and intensity level of the workout, the athlete's body composition and ambient conditions such as the temperature and the atmospheric humidity. In order to compensate for this loss of fluid, athletes must consume sufficient fluid before, during and after a workout. An athlete's fluid balance can be easily monitored by checking how much urine the athlete passes (one to two litres per day is normal) and by checking the colour of the urine. If the urine is virtually colourless, the athlete's fluid balance is probably good. Dark urine is a sign that an athlete needs more fluid. In order to replenish fluids, one must drink 150 percent of the fluid lost from sweating.¹⁷

Sometimes, water alone will not be sufficient. When an athlete is completing a long, high-intensity workout, e.g. a marathon or a four-hour bike ride, he/she can

replenish his/her store of carbohydrates and minerals by using a good sports drink in a sensible manner. Sports drinks contain approximately 60-80 grams of carbohydrates per litre. Recovery drinks often contain even more carbohydrates. Drinking sports and/or recovery drinks will give you additional energy, which may cause athletes who do not actually need the additional energy to become overweight. For a personal recommendation on the use of such sports drinks, we advise athletes to consult a dietician or sports nutritionist.

In addition to sports drinks, the market provides all sorts of products and supplements for athletes, such as sports gels, protein bars and protein supplements. Under certain athletic conditions, such products or supplements may help an athlete improve his/her performance by allowing the athlete to meet his/her nutritional requirements, particularly if the athlete is an elite athlete. However, such products and supplements are generally unnecessary for recreational athletes and should never be used as a substitute for a healthy regular diet.

Sports supplements or multivitamins

There are many sports supplements and multivitamins on the market, even though there is no scientific consensus on their effect on athletes' performance or post-workout recovery. The use of supplements is not necessarily risk-free. The European Food Safety Authority (EFSA) has established tolerable upper intake levels for all sorts of vitamins, minerals and trace metals. EFSA recommends not taking any multivitamins that exceed these tolerable upper intake levels.

Some sports supplements, 'pre-workout' products, weight loss pills and 'fat burners' may contain substances that are not listed on the packaging and may even have a detrimental effect on one's health. In addition,



they may contain substances that are, or used to be, registered as medicines, but have since been withdrawn from the market due to a risk of side effects. In addition, sports supplements may contain substances that are considered doping.²⁰ Please consult www.dopingautoriteit.nl/NZVT to find an overview of food supplements that have been assessed by the Dutch Safeguards System for Dietary Supplements in Elite Sport. The Anti-Doping Authority of the Netherlands has also developed a few useful apps, i.e., the Supplementenwijzer App and the Dopingwaaier app, which will allow you to check whether a given supplement contains ingredients that are considered doping.

Consensus on sports supplements' effect on athletic performance or post-workout recovery

A healthy diet supplies all the nutrients and energy a person needs to exert him or herself, and forms the basis for a good athletic performance, regardless of the athlete's skill level. Recreational athletes do not need additional vitamins on top of a healthy diet. In addition to a healthy diet, there are several supplements that may have a positive effect on an athlete's performance or may help him/her make a quicker post-workout recovery. Caffeine and creatine monohydrate sports supplements may help athletes perform just a tiny bit better.²¹

Caffeine

Caffeine stimulates the central nervous system, thus increasing alertness, reaction time and wakefulness. Caffeine also affects muscle metabolism. Because caffeine has these effects, it may enhance athletic performance.

Ingesting caffeine may help endurance athletes enhance their performance by approximately 1.5% to 3%.²²⁻²³ Although caffeine's positive effects on endurance athletes have been demonstrated, it is less

certain that they have a positive effect on a brief workout.^{21,24-25} Moreover, a caffeine overdose may have negative effects, such as headache, an elevated heart rate, gastrointestinal complaints and sleep problems.^{23,25} Both the positive and the negative effects may vary from person to person.

Creatine

The consumption of creatine monohydrate, colloquially known as creatine, may have a performance-enhancing effect on high-intensity and explosive types of exercise, such as sprinting and jumping, in many elite athletes.²¹ This performance-enhancing effect is due to increased muscular strength, which in turn is due to larger amounts of phosphocreatine stored in the muscles during repeated workouts. Increased muscular strength directly results in better performance, but also indirectly causes athletic performance to improve, as it allows athletes to engage in higher-intensity workouts.²⁶ In addition to its performance-enhancing qualities, creatine has been proved to speed up the recovery process. For instance, athletes who take this supplement after a high-intensity workout will be restored to their original level more quickly. They will also enjoy a quicker recovery from muscle damage in the days following the workout.²⁶ Creatine has been tested extensively and appears not to have any detrimental effects, provided that athletes do not exceed the recommended doses.

Creatine intake does cause athletes' bodies to retain more water. As a result, an athlete's body weight will on average increase by one kilogram. This weight gain is not desirable in athletes playing sports in which a low body weight is vital.

Special attention should be paid to athletes' vitamin D levels, as vitamin D deficiency may have a detrimental effect on athletic performance.¹⁷ A sub-optimal vitamin D status is also common among athletes. However, taking additional vitamin D on top of the recommended daily intake will not result in improved athletic performance, and is therefore unnecessary. Young children, elderly people, dark-skinned people, people who do not spend much time outside and pregnant women are generally advised to take a vitamin D supplement.

No consensus

Although they may be popular with athletes, the effect of the following supplements on athletic performance or post-workout recovery is still a topic of debate:



Beetroot juice

Beetroot juice contains nitrate. The body is able to convert nitrate into nitric oxide. This substance causes the blood vessels to dilate, which causes the circulation of muscles to improve, which in turn increases the level of oxygen in the blood. It is clear that beetroot juice (more specifically, nitrate) can have a positive effect on recreational athletes' endurance, but there has so far been no evidence for its added value for elite athletes.²⁷ Furthermore, it is unknown what long-term effects high doses of nitrate may have on our health. For this reason, athletes are advised to use nitrate-rich sports supplements sparingly, and not to use them on a daily basis for a long period of time.

Magnesium

Magnesium, a mineral, plays an important role in the body. For instance, it is involved in muscle action, the formation of bone and nerve conduction. Magnesium deficiency is very rare, because many food products, such as bread, vegetables and meat, contain this mineral. However, if an athlete were found to suffer a magnesium deficiency, magnesium supplements would be advisable. There is no consensus on the added value of additional magnesium with regard to athletic performance. A few studies have demonstrated a positive effect, but there have also been studies in which added magnesium was found not to create any added value.²⁸ There seems to be no evidence that taking magnesium will prevent muscle cramps.²⁹

Beta-alanine

Beta-alanine is a substance that can buffer acid and is therefore said to be able to prevent athletes' muscles from building up lactic acid. If this were true, it would have a positive effect on athletic performance. However, in practice, this is not necessarily the case. There has been one study that demonstrated a positive effect on performance, but there have also been several studies that did not find any effect at all.³⁰ If it works at all, it does so only for short, high-intensity workouts lasting up to six minutes. In addition, ingestion of beta-alanine may cause physiological symptoms, such as a tingling sensation in hands and feet.

Sodium bicarbonate

Like beta-alanine, sodium bicarbonate (a.k.a. baking soda) is able to buffer lactic acid. Approximately half of the studies conducted on the subject showed that sodium bicarbonate positively affects athletic performance, while the other half failed to show a positive effect.³¹ Sodium bicarbonate is most likely to positively enhance performance during workouts that cause the muscles to build lactic acid quickly – for instance, high-intensity efforts that only last a few minutes, or team sports requiring repeated explosive

actions. Athletes who wish to try taking sodium bicarbonate would be wise to take this supplement as a capsule that does not dissolve until it reaches the intestines. If sodium bicarbonate meets the acidic environment of the stomach, it will lose a great deal of its buffering capacity and may cause stomach complaints. Ingestion of sodium bicarbonate results in the athlete consuming a great deal of sodium, which may result in high blood pressure. Athletes suffering from high blood pressure should not take large quantities of sodium bicarbonate for a long period of time. Because of the aforementioned side effects, we recommend that athletes (particularly recreational athletes) refrain from using this supplement.

Fish oil (omega-3 fatty acids)

Omega-3 fatty acids, which can predominantly be found in fatty fish, protect the muscles from damage after a workout.³² There are indications that these fatty acids may promote the formation of muscle protein. In addition, ingestion of 3 grams of fish oil per day may positively contribute to the immune system, since these fatty acids indirectly activate white blood cells, which play a vital part in a properly functioning immune system.³² Although omega-3 fatty acids protect against cardiovascular disease and fit into a healthy diet, there are no indications that fish oil actually enhances athletic performance.

No evidence base for any effect on athletic performance or post-workout recovery

The following supplements have not been demonstrated to affect athletic performance or post-workout recovery. Therefore, healthy people are advised not to use the following supplements for these purposes: vitamin supplements, ribose, coenzyme Q10, ginseng, glucosamine, chromium picolinate, oxygenated water, medium-chain triglyceride (MCT) oil, zinc monomethionine aspartate (ZMA), inosine, probiotics and pyruvate.

For more information and recommendations on caffeine, creatine, beetroot juice, beta-alanine and sodium bicarbonate, please consult the Topsport Topics section at www.allesoversport.nl

Looking at the future

Although this fact sheet provides athletes with all sorts of useful recommendations, it is still a good idea for athletes to check what works for them (within safe boundaries) under the supervision of a dietician or sports nutritionist. Since scientific insights are constantly changing, we will continue to follow trends in the fields of nutrition and sport so as to be able to provide definitive and, where necessary, updated views.

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