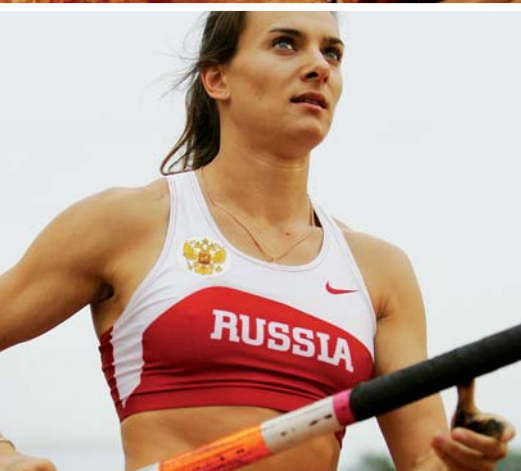
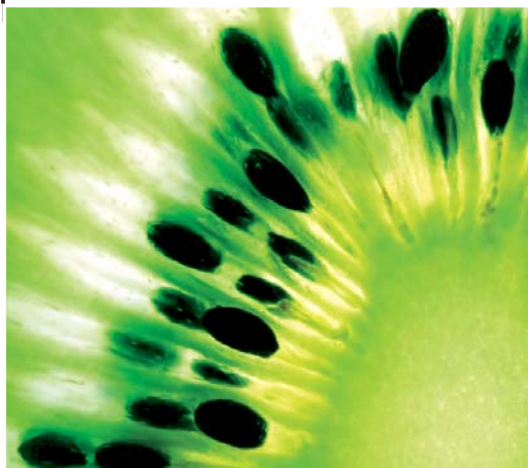


NUTRITION

for **ATHLETICS**

A PRACTICAL GUIDE
TO EATING AND DRINKING FOR
HEALTH AND PERFORMANCE
IN TRACK AND FIELD



BASED ON AN IAAF INTERNATIONAL
CONSENSUS CONFERENCE HELD IN
MONACO IN APRIL, 2007

Updated May 2013





MESSAGE FROM THE PRESIDENT



The IAAF is proud to present this booklet of nutritional advice for athletes.

"All athletes can benefit from making good food choices that will support consistent training, maximise performance in competition and help maintain good health.

Food choices will be very different in different countries and different cultures, but the basics of good nutrition remain the same: a wide variety of healthy and wholesome foods eaten in appropriate amounts should be the primary elements of every athlete's diet.

The IAAF is committed to helping athletes in all the countries of the world to achieve their performance, personal and health goals. This booklet is part of that commitment."

Lamine Diack
IAAF President



The Coca-Cola Company, via the POWERADE, brand, has formed a very successful partnership with the International Association of Athletics Federations (IAAF). The partnership has created this nutrition brochure which we hope will provide you with practical information.

We are delighted to support athletes as they pursue their personal goals. One way we do this is through the POWERADE sports drink brand. It was developed to help athletes perform at their best, thanks to its formulation, which can help delay the onset of fatigue during exercise and prevent dehydration.

This brochure recognizes the importance of diet as a crucial part of sporting performance and we hope you will find the information useful.

Muhtar Kent
Chairman of the Board & CEO
The Coca-Cola Company



THE BENEFITS OF EATING WELL

A well-chosen diet offers many benefits to all athletes, irrespective of event sex, age or level of competition:

- Optimal gains from the training programme
- Enhanced recovery within and between workouts and events
- Achievement and maintenance of an ideal body weight and physique
- A reduced risk of injury and illness
- Confidence in being well-prepared for competition
- Consistency in achieving high-level performances
- Enjoyment of food and social eating occasions

Despite these advantages, many athletes do not meet their nutrition goals. Common problems and challenges include:

- Poor knowledge of foods and drinks and inadequate cooking skills
- Poor choices when shopping or dining out
- Poor or outdated knowledge of sports nutrition
- Inadequate finances
- Busy lifestyle leading to inadequate time to obtain or consume appropriate foods
- Poor availability of good food and drink choices
- Frequent travel
- Indiscriminate use of supplements and sports foods

The information in this booklet is designed to provide athletes and coaches with an overview of the latest guidelines in sports nutrition. While there is no such thing as a magic diet or food, there are many ways in which eating and drinking well can allow athletes at all levels of performance to achieve the special goals of their training and competition programmes. It makes no sense to train hard and ignore the benefits that follow from good food choices.

This booklet was prepared for the IAAF Medical and Anti-Doping Commission by

Professor Louise Burke, Australia
Professor Ron Maughan, UK

We thank all the participants in the IAAF international consensus conference for their insight and comments in the preparation of this booklet.



KEY MESSAGES

Whenever highly talented, motivated and well-trained athletes meet in competition, the margin between victory and defeat is small. Attention to detail can make that vital difference. Diet affects performance, and our eating and drinking patterns will influence how well we train and whether we compete at our best. All athletes need to be aware of their personal nutritional goals and of how they can select an eating strategy to meet those goals.

Athletics covers a wide range of events which require varying inputs of technique, strength, power, speed and endurance. Each athlete is also different, and there is no single diet that meets the needs of all athletes at all times. Individual needs also change across the season and athletes must be flexible to accommodate this.

Diet may have its biggest impact on training, and a good diet will help support consistent intensive training while limiting the risks of illness or injury. Good food choices can also promote adaptations to the training stimulus.

Getting the right amount of energy to stay healthy and to perform well is key. Consuming too much energy increases body fat: too little, and performance falls, injuries are more likely to occur, and illness results.

Carbohydrate supplies the muscles and brain with the fuels they need to meet the stress of training and competition. Athletes must be aware of what foods they should choose to meet their carbohydrate needs, how much should be eaten, and when these foods should be eaten.

Foods rich in protein are important for building and repairing muscles, but a varied diet containing everyday foods will generally supply more than enough protein. With protein also, the timing of intake in relation to training and competition may be important and taking a small amount of protein-containing foods soon after training may help to promote adaptations taking place in the muscles. Well-chosen vegetarian diets can easily meet protein needs.

A varied diet that meets energy needs and is based largely on nutrient-rich choices such as vegetables, fruits, beans, legumes, cereals, lean meats, fish and dairy foods should ensure an adequate intake of all the essential vitamins and minerals. Excluding any of these food groups increases the risk of missing out on important nutrient needs and means that more careful food choices must be made.

Maintaining hydration is important for performance. Fluid intake before, during (where appropriate) and after both training and competition is important, especially in hot climates and at altitude. When sweat losses are high, foods and drinks must also contain sufficient salt to replace the salt lost in sweat.

All athletes are cautioned against the indiscriminate use of dietary supplements, and young athletes are actively discouraged from supplement use.

This booklet contains information that will help athlete at all levels of competition to make informed choices to meet their nutritional needs in different situations. This booklet tries to give practical information that will be of use to the serious athlete, but is not a substitute for individual advice from a qualified professional.





PART 1 | General principles: nutrition goals and eating strategies

- Energy balance, body mass and body composition
- Protein needs for training
- Carbohydrates for training
- Hydration
- Vitamins, minerals and anti-oxidants for training and staying healthy
- Supplements
- Special needs of the young athlete
- Special needs of the female athlete

PART 2 | Event specific nutrition

- Sprints, Jumps and Multi-Events
- Middle distance running
- Distance running and race walking
- Throws

PART 3 | Eating strategies

- Practical challenges to achieving nutrition goals
- Eating strategies for the travelling athlete
- Environmental challenges
- Cultural and regional issues



PART 1 | GENERAL PRINCIPLES

NUTRITION GOALS & EATING STRATEGIES

Every athlete is different. Not only do they have different requirements for energy and nutrients depending on body size and physique and on their event and training load, but in addition they have individual physiological and biochemical characteristics that shape their nutrient needs. Each athlete must therefore identify key nutritional goals, in terms of the requirement for energy, protein, carbohydrate, fat and all of the vitamins and minerals that are essential for health and performance.

Athletes also like to make different food choices, based in part on cultural and lifestyle issues, but

perhaps more on personal taste preferences. Once nutritional goals are identified, each athlete must therefore devise an eating strategy to ensure that suitable foods are eaten in appropriate amounts at the right times to meet those goals.

While the general principles are simple, the detail is more complex, and the serious athlete will see professional help to ensure that health and performance are not jeopardised by poor dietary choices. Accredited sports dietitians and qualified sports nutritionists are able to give expert advice that athletes can trust.

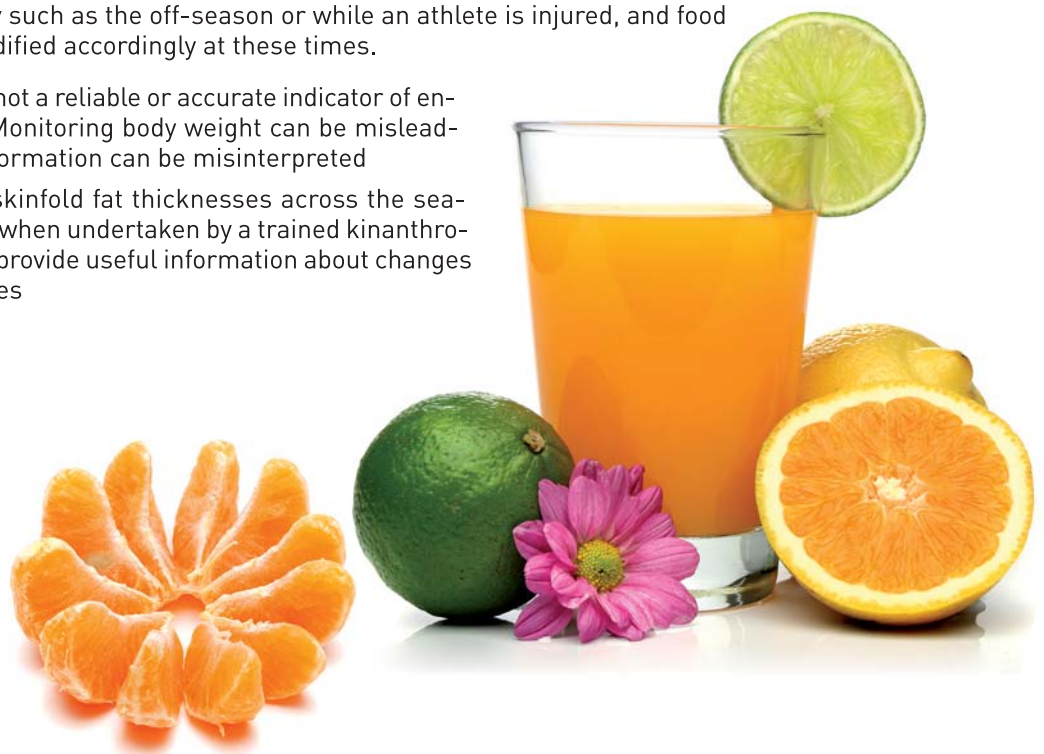
Energy balance, body mass and body composition

The foods we eat and the fluids we drink provide for the immediate energy needs of the body as well as influencing body energy stores. Energy stores play a number of important roles related to exercise performance, since they contribute to

- size and physique (e.g. body fat and muscle mass)
- function (e.g. muscle mass)
- fuel for exercise (e.g. muscle and liver carbohydrate)

How much food an athlete needs to eat will depend largely on energy needs, and there is no simple formula to predict this. Energy needs depend not only on the demands of training and competition, but also on energy expenditure outside these activities. For those who train very frequently, or when training sessions are long and hard, the energy demands will be high. For those who train infrequently, or where training sessions are short or easy, the energy demands will not be high. Similarly, energy needs are lower during periods of inactivity such as the off-season or while an athlete is injured, and food intake must be modified accordingly at these times.

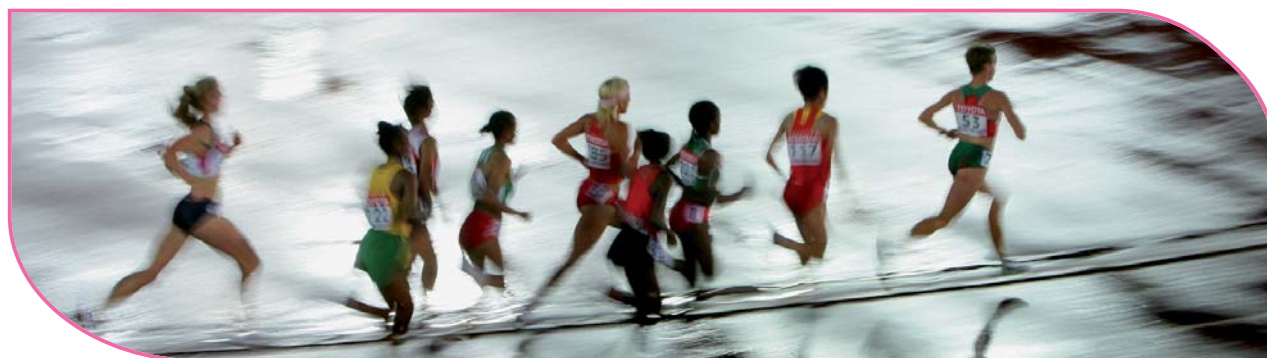
- Body weight is not a reliable or accurate indicator of energy balance. Monitoring body weight can be misleading, and the information can be misinterpreted
- Monitoring of skinfold fat thicknesses across the season, especially when undertaken by a trained kinanthropometrist, can provide useful information about changes in body fat stores





At times, there may be a need to manipulate energy intake to achieve specific objectives, such as increasing muscle mass or reducing body fat levels. This requires careful management to ensure that the goal is achieved while conserving the ability to train consistently and effectively. Increasing body weight will not be helpful for the jumper who wants to increase power and sprinting speed if the weight is gained as body fat rather than muscle. Simply eating more will not necessarily be the solution. Likewise, reducing body fat may be necessary for some athletes at some stage of their career, but if this is done incorrectly, it will do more harm than good. When a reduction in body fat content is necessary, this should be achieved gradually and without compromising the athlete's ability to consume an adequate intake of fuel and important nutrients. Athletes can avoid potential problems by taking care to avoid excess weight gain in the off-season or while injured. Careful management of both diet and activity levels in the off-season and during the early part of the competitive season can help the athlete to reach his or her ideal weight and body fat level with minimal effect on health or performance.

Energy availability = total dietary energy intake – energy used in daily activity/training



There is evidence from recent research that there are substantial impairments of metabolic and hormonal function when energy availability drops below a daily intake of 30 kcal (135 kJ) per kg fat-free mass (FFM). This deficiency can affect performance, growth and health. In females, one outcome of low energy availability is a disturbance of reproductive function and menstrual regularity. Other problems are likely to occur in male athletes.

Example of low energy availability:

50 kg female with 20% body fat = 40 kg FFM

Daily energy intake is 1500 kcal (6300 kJ)

Cost of daily exercise (1 h/d) = 600 kcal (2520 kJ)

Energy availability = 1500-600 = 900 kcal (3780 kJ)

Energy availability = 900/40 or 22.5 kcal/kg FFM (95 kJ per kg FFM)

Athletes who require advice for weight loss or fat loss should seek guidance from a qualified sports nutrition expert such as a sports dietician. To avoid irreversible damage to bones, any female athlete with disruption of normal menstrual function should be referred without delay to a medical expert for investigation.



PART 1 | GENERAL PRINCIPLES

NUTRITION GOALS & EATING STRATEGIES

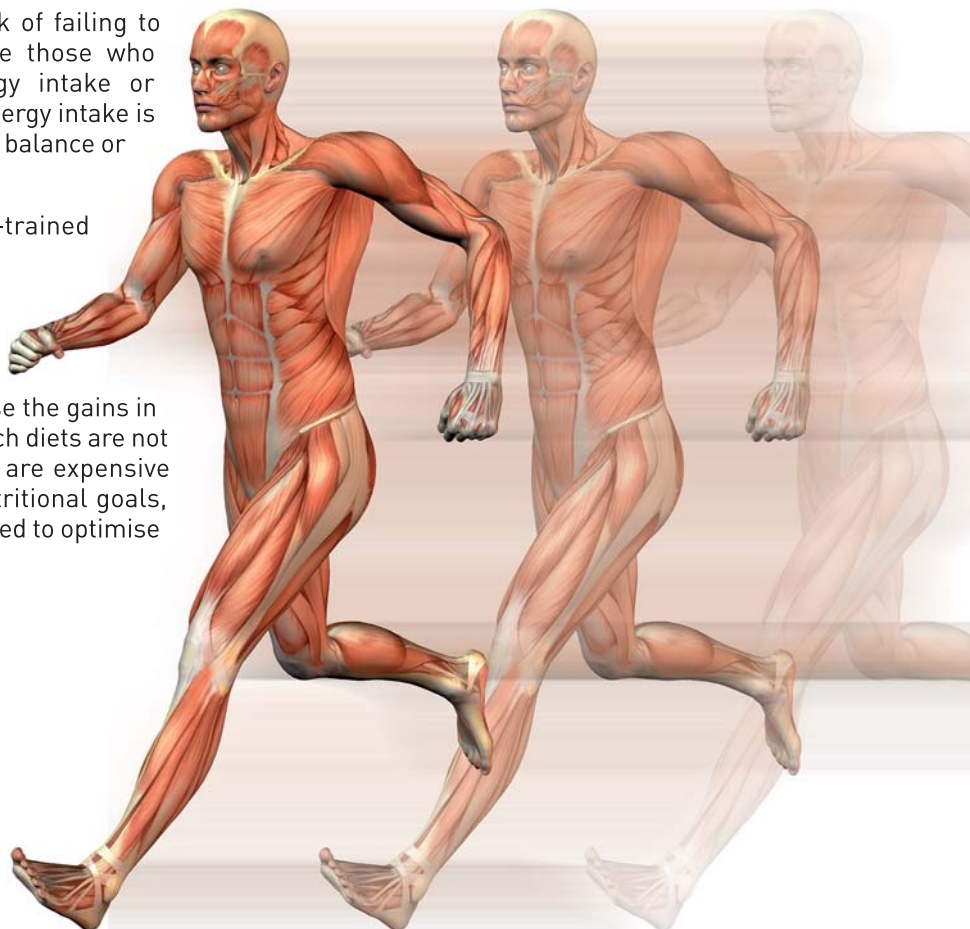
Protein needs for training

Protein has been considered a key nutrient for sporting success by athletes of all eras and in all sports. Whereas ancient Olympians were reported to eat unusually large amounts of meat, today's athletes are provided with a vast array of protein and amino acid supplements to increase their protein intakes.

Protein plays an important role in the response to exercise. Amino acids from proteins are the building blocks for the manufacture of new tissue including muscle, and the repair of old tissue. They are also the building blocks for hormones and enzymes that regulate metabolism and other body functions. Protein provides a small source of fuel for the exercising muscle.

Some scientists have suggested that endurance and resistance-trained athletes in heavy training will have increased daily protein needs - up to a maximum of 1.2-1.7 grams of protein per kg body weight (BW), compared to the recommended intake of 0.8 g/kg BW for a sedentary person. However, the evidence for this increase in protein needs is not clear or universal. Part of the confusion is caused by problems involved in scientific techniques used to measure protein requirements.

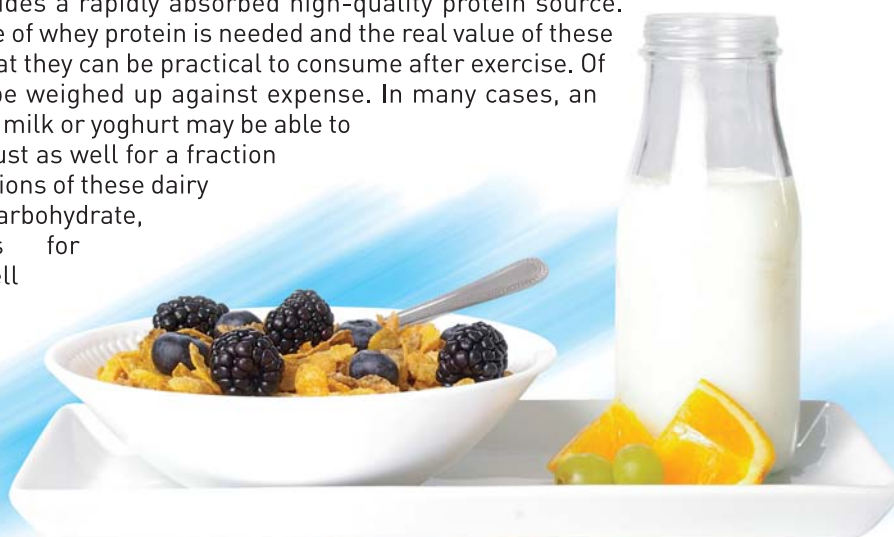
- ▶ The debate over the precise protein needs of athletes is largely unnecessary. Dietary surveys show that most athletes already consume diets providing protein intakes above the maximum recommended level, even without the use of protein supplements. Therefore, most athletes do not need to be encouraged or educated to increase their protein intakes. These surveys, however, relate mostly to athletes who eat typical Western-style diets. More information is urgently needed on athletes who follow different food customs or eat other types of foods.
- ▶ Athletes who are most at risk of failing to meet their protein needs are those who severely restrict their energy intake or dietary variety. An adequate energy intake is important in promoting protein balance or increasing protein retention.
- ▶ Although some resistance-trained athletes and body builders consume more than 2-3 g/kg BW, there is no evidence that these high daily protein intakes enhance the response to training or increase the gains in muscle mass and strength. Such diets are not necessarily harmful, but they are expensive and can fail to meet other nutritional goals, such as providing the fuel needed to optimise training and performance.





Recent studies have focused on the acute response to workouts of both endurance and resistance exercise. Enhanced protein balance is a desirable goal of the recovery phase – to overturn the increased rates of protein breakdown that occur during exercise, and to promote muscle growth, repair and adaptation following the exercise stimulus. These studies have found that eating high-quality protein after a training session enhances protein synthesis during the recovery period. A worthwhile effect is achieved with as little as 10 g of protein, while the maximal effect occurs with the intake of 20-25 g of protein (see the box below for a guide to the protein content of everyday foods). Protein derived from animal sources such as dairy, eggs, meats, fish and poultry is all high-quality. A well chosen vegetarian diet can provide adequate total protein intake over the day, with the full complement of essential amino acids being provided by mixing and matching plant protein sources. However, some studies have shown that although recovery eating based on vegetable protein foods such as soy milk can promote protein synthesis after exercise, it is not as effective as an animal source like dairy milk.

Whey protein is particularly popular as a recovery supplement, or supplement ingredient because it provides a rapidly absorbed high-quality protein source. However, only a small serve of whey protein is needed and the real value of these recovery supplements is that they can be practical to consume after exercise. Of course, practicality must be weighed up against expense. In many cases, an everyday dairy food such as milk or yoghurt may be able to look after recovery needs just as well for a fraction of the cost. Sweetened versions of these dairy foods can provide protein, carbohydrate, fluid and electrolytes for immediate recovery, as well as other nutrients like calcium for total health and well-being.



Protein rich foods – 10 g protein is provided by any of the following:

2 small eggs	2 cups cooked pasta or 3 cups rice
300 ml cow's milk	400 ml soy milk
20 g skim milk powder	60 g nuts or seeds
30 g cheese	120 g tofu or soy meat
200 g yoghurt	150 g legumes or lentils
35-50 g meat, fish or chicken	200 g baked beans
4 slices bread	150 ml fruit smoothie or liquid meal supplement
90 g breakfast cereal	



Carbohydrates for training

Carbohydrate provides an important, but relatively short-lived, supply of fuel for exercise, and the storage depots, in the form of glycogen, must be refilled each day from carbohydrate foods in the diet. Everyday eating and drinking plans for athletes need to provide enough carbohydrate to fuel their training programmes and to optimise the recovery of muscle glycogen stores between workouts. General targets can be provided for carbohydrate needs, based on the each individual's size and the demands of their training programme (see Table below).

Targets for carbohydrate intake

Immediate recovery after fuel-depleting exercise (0-4 hours): about 1 g per kg of body weight per hour, consumed at frequent intervals

Daily recovery for a low volume training programme: 3-5 g per kg BM per day

Daily recovery from a moderate training load: 5-7 g per kg BW per day

Recovery from moderate-heavy endurance training: 6-10 g per kg BW per day

Maximised fuelling up for a distance event (e.g. carbohydrate loading): 10-12 g per kg BW per day

Special comments about guidelines for carbohydrate:

- Guidelines for carbohydrate should not be provided as a percentage of total dietary energy intake – for example 50% of energy intake. Such recommendations are not particularly “user-friendly” – most athletes and coaches don't know how to choose meals based on such a target. In addition, these guidelines are a poor way to ensure that the athlete meets a certain target for fuel intake. After all, an athlete who eats fifty percent of a high energy intake from carbohydrate will eat much more carbohydrate than an athlete who eats fifty percent of a low energy intake from carbohydrate.
- The new guidelines recommend daily amounts of carbohydrate in grams, on a sliding scale which changes with the athlete's size and the fuel costs of the training/competition schedule (see box). However, actual needs are specific to the individual athlete and need to be fine-tuned with consideration of the total energy needs and specific training goals. It is important to get feedback from performance in training and competition to assess whether there is a problem with fuel availability and to fine-tune carbohydrate intake accordingly.
- We no longer promote the idea that every athlete should aggressively eat a “high carbohydrate diet” since this term can be misunderstood. Rather we promote the concept that athletes should eat sufficient carbohydrate to meet the fuel needs of their training programme, with special attention to sessions where they need to train well or at high intensity. Different athletes may need to eat different amounts of carbohydrate to meet the fuel needs of their training or competition programmes, and this may change at different times of the season (see box). Yet, in each of these situations the athlete has achieved the goal of eating a diet with high carbohydrate availability for their exercise needs.





Strategies for choosing carbohydrate foods and drinks and for optimising glycogen recovery

- ▶ When the gap between training sessions is less than approximately 8 hours (as when training twice daily), carbohydrate intake should start as soon as practicable after the first session to maximise the effective recovery time. There may be some advantages in meeting carbohydrate targets through a series of snacks during the early recovery phase. Solid and liquid forms of carbohydrate are both suitable for recovery eating, but some choices may be more practical than others because of appetite, convenience or personal preferences.
- ▶ During longer recovery periods (24 hours), the pattern and timing of carbohydrate-rich meals and snacks do not appear to be critical, and can be organised according to what is practical and comfortable for each athlete. Given the amount of carbohydrate that may need to be consumed, high carbohydrate foods will need to be spread out over the full 24 hours.
- ▶ It is valuable to choose nutrient-rich carbohydrates and to add other foods to recovery meals and snacks to provide a source of protein and other nutrients. These nutrients may assist in other recovery processes, and in the case of protein, may promote additional glycogen recovery when carbohydrate intake is below fuel intake targets.
- ▶ Adequate energy intake is also important for optimal glycogen recovery; the restrained eating practices of some athlete, particularly females, make it difficult to meet carbohydrate intake targets and to optimise glycogen storage from this intake.

Examples of snacks or meal combinations providing nutrient-rich carbohydrates and protein sources

Breakfast cereal with milk and fruit
Fruit with flavoured yoghurt
Fruit smoothie or liquid meal supplement
Sandwich with meat and salad filling
Meat or chicken stir-fry with vegetables and rice or noodles





PART 1 | GENERAL PRINCIPLES

NUTRITION GOALS & EATING STRATEGIES

Hydration

A good hydration strategy is an essential part of every athlete's preparation for competition. Commercial sports drinks have been developed on sound scientific principles, and athletes can turn this science into optimal performance and well-being by learning the practical aspects of what to consume during their event. They also need to look at the timing of consumption and the amounts needed for optimum performance. Just as general training and competition strategies should be tailored for individual athletes in accordance with their unique needs and preferences, so should their drinking and eating choices before and during exercise. Athletes, coaches and support staff should 'fine tune' these recommendations to identify their own winning formula, and to know how to manipulate this in hot or cold environments.

How much and when to drink?

- ▶ Limit dehydration during training and competition by drinking water or a sports drink. Other drinks may also be appropriate but it would be wise to check how these fit into your overall hydration and nutrition plan.
- ▶ Being thirsty can be a useful signal of fluid loss and some scientists suggest that drinking when you are thirsty is all that is needed to guide fluid intake during exercise. However, in some situations it is not possible to get access to drinks only when you are thirsty, or to drink enough at a single timepoint to prevent ongoing thirst. In these situations, the athlete might develop a fluid plan which helps them to spread their fluid intake across the available drinking times so that it keeps pace with total needs (see next point).
- ▶ Get a feel for sweat rates during exercise so that drink practices can be adjusted accordingly (see box). It is not necessary to drink enough to prevent loss of body weight, but the amount of dehydration should normally be limited to a loss of less than approximately 2% of body weight (i.e., 1.0 kg for 50 kg person, 1.5 kg for a 75 kg person, and 2 kg for a 100 kg person).
- ▶ Since the negative effects of dehydration on high-intensity performance are generally greater in warm environments and at altitude, upgrade drinking practices in these conditions to minimise the overall fluid deficit. This may mean drinking before and during longer events such as distance running and walking, but may also include drinking between attempts in jumps and throws and between rounds where there is more than one event in a day.
- ▶ Don't drink at rates that are greater than sweat losses so that you actually gain weight during the competition period. (Unless for some unavoidable reason, you were dehydrated when the event started.)

When do you need more than water?

- ▶ In events lasting longer than approximately ~ 1 hour, consuming carbohydrate can enhance performance by providing additional fuel to the muscle or brain.
- ▶ Consuming carbohydrate during distance running and walking races is likely to promote faster race times. New studies show that carbohydrate needs during exercise differ according to the duration of the event/session. Each athlete should practice their strategies in training or less important races to develop their own specific plan (see distance event section). Sports drinks, with a typical carbohydrate content of 4-8% (4-8 g/100 ml), can provide fuel and fluid needs to be met simultaneously in most events, but some individuals may benefit from lower or higher carbohydrate concentrations. Sports gels or confectionery can be used for an extra carbohydrate boost.
- ▶ Consuming a carbohydrate-containing drink (or light foods) may help to maintain skills and judgement in prolonged competitions where athletes become fatigued. The last throw or the last jump is often the most important.
- ▶ Sodium should probably be included in fluids consumed during events lasting longer than 1-2 hours or by individuals who are "salty sweaters" (Salty sweat usually leaves a white crust on the skin or clothes when it evaporates).
- ▶ Caffeine is present in many commonly available beverages and sports foods, and can enhance both physical and mental performance. This benefit can be obtained with the relatively small doses of caffeine that are commonly consumed by people of various cultures (e.g. about 2-3 mg/kg bodyweight).



How to estimate sweating rate:

Measure body weight (kg) both before and after at least one hour of exercise under conditions similar to competition or a hard practice. These readings should be made with the athlete wearing minimal clothing and while bare footed. The post-exercise reading should be taken as soon as is practical after the session, and after towel-drying.

Note the volume of fluid consumed during exercise (litres)

Calculations

Sweat loss (litres) = Body weight before exercise (kg) - Body weight after exercise (kg) + fluid consumed during exercise (litres)

To convert to a sweat rate per hour, divide by the exercise time in minutes and multiply by 60

Note: 2.2 pounds equals 1.0 kg and converts to a volume of 1.0 litre or 1,000 ml or 34 ounces of water.



Rehydration after exercise

Recovery after exercise is part of the preparation for the next exercise session, and replacement of sweat losses is an essential part of this process. Both water and salts lost in sweat must be replaced.

- Aim to drink about 1.2-1.5 litres of fluid for each kg of weight lost in training or competition.
- Drinks should contain sodium (the main salt lost in sweat) if no food is eaten at this time. Sports drinks that contain electrolytes are helpful, but many foods can also supply the salt that is needed (e.g. bread, breakfast cereals, cheese, crackers). A little extra salt may be added to meals when sweat losses are high, but salt tablets should be used with caution.

Just like new shoes, don't try out new plans for fluid and fuel replacement at a major competition. Try this first in training and then at minor events to find out what works best for you.



PART 1 | GENERAL PRINCIPLES

NUTRITION GOALS & EATING STRATEGIES

Vitamins, minerals and anti-oxidants for training and staying healthy

Strenuous bouts of prolonged exercise and heavy training, particularly aerobic exercise, stress the body. Adequate intakes of energy, protein, vitamins and minerals are all important to health and performance. These nutrients are best when obtained from a varied diet based largely on nutrient-rich foods such as vegetables, fruits, beans, legumes, grains, lean meats, fish, dairy products and unsaturated oils. As well as providing our known nutrient needs, these foods also contain a range of other compounds such as the phytochemicals in plant foods, about which we are continually discovering new and exciting information. Choosing food based sources of these chemicals is a sound idea since it makes use of their interactions within food to enhance bioavailability, and it means that you may also consume other compounds that are yet to be identified. Dietary surveys show that most athletes are able to meet the recommended intakes for vitamins and minerals by eating everyday foods. Those at risk of sub-optimal intakes of these micronutrients include:

- ▶ athletes who restrict their energy intake, especially over long periods, to meet weight loss goals
- ▶ athletes who follow eating patterns with restricted food variety and reliance on foods with a poor nutrient-density

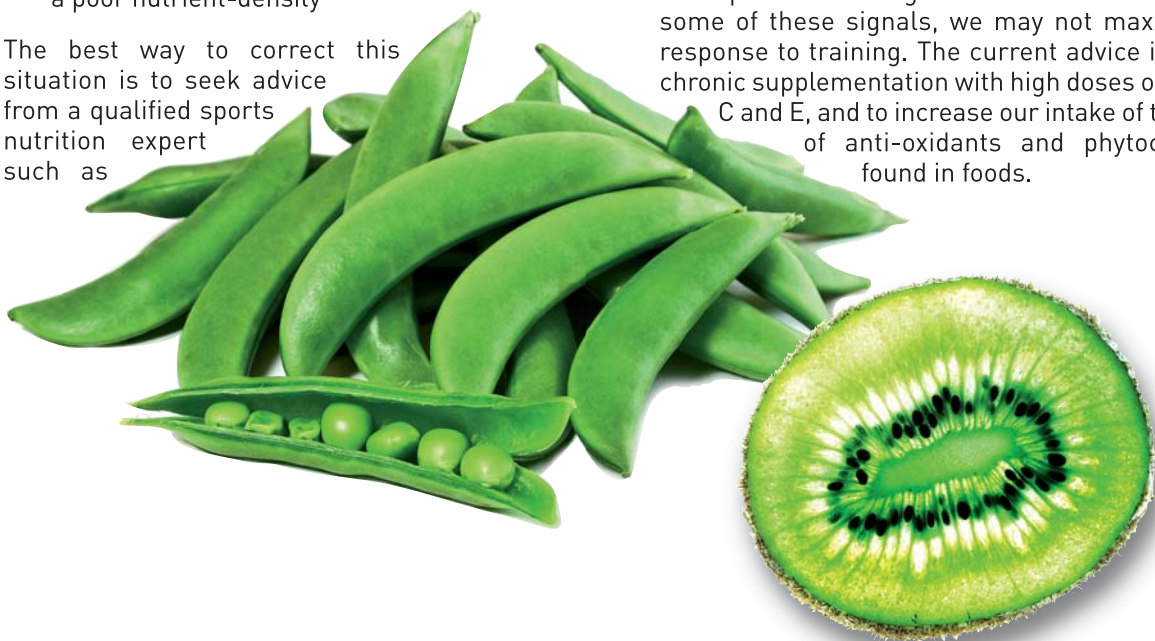
The best way to correct this situation is to seek advice from a qualified sports nutrition expert such as

a sports dietician. When food intake cannot be adequately improved – for example, when the athlete is travelling in a country with a limited food supply – or if an individual is found to be suffering from a lack of a particular vitamin or mineral, then supplementation can be warranted. In general, a broad-range multivitamin/mineral supplement is the best choice to support a restricted food intake, although targeted nutrient supplements may be necessary to correct an established nutrient deficiency (e.g. iron deficiency).

Anti-oxidant nutrients

Anti-oxidant nutrients are important in helping protect the body's tissues against oxidative stress. Since exercise increases the generation of oxidative species, it sounds logical that athletes who train hard might benefit from anti-oxidant supplementation. However, studies in which athletes have been supplemented with common anti-oxidants such as Vitamin E and C have not shown advantages to training and performance outcomes. In fact, several studies have shown the opposite effects. We now know that some oxidative stress is important – it provides a signal to the body to upgrade its own anti-oxidant defences. But new work also shows that oxidative stress provides signals that help the muscle to adapt to the training stimulus itself. If we knock out some of these signals, we may not maximise our response to training. The current advice is to avoid chronic supplementation with high doses of Vitamins C and E, and to increase our intake of the variety

of anti-oxidants and phytochemicals found in foods.





Ideas for promoting dietary variety and nutrient-rich eating

- ▶ Be open to trying new foods and new recipes (though not just before important competitions!)
- ▶ Make the most of fresh foods in season
- ▶ Explore all the varieties of different foods
- ▶ Mix and match foods at meals
- ▶ Think carefully before banishing a food or group of foods from your eating plans
- ▶ Include fruits and vegetables at every meal. The strong colours of many fruits and vegetables are a sign of a high content of various vitamins and other food anti-oxidants. Aim to fill your plate with highly coloured foods to ensure a good intake of the range of these health-promoting dietary compounds. It is good to ensure that you “eat a rainbow” each day by choosing fruits and vegetables from each of the following schemes:
 - ▶ White – e.g. cauliflowers, bananas, onions, potatoes
 - ▶ Green – e.g. broccoli, lettuce, green apples and grapes
 - ▶ Blue/purple – e.g. blueberries, plums, purple grapes, raisins
 - ▶ Orange/Yellow – e.g. carrots, apricots, peaches, oranges, cantaloupe, mangoes
 - ▶ Red – tomatoes, watermelon, cherries, berries, red apples, red peppers



Special concerns

IRON. Iron deficiency is the most common nutrient deficiency in the world. It may occur in athletes and can impair training and competitive performance. Unexplained fatigue, especially in vegetarian eaters should be explored with a sports physician and sports nutrition expert. Routine use of iron supplements is not wise: too much is just as harmful as too little. Self-medication with iron supplements may not address the real problem that is causing fatigue, or solve the cause of poor iron status.

CALCIUM. Calcium is important for healthy bones. The best sources are dairy foods, including low fat

varieties. Fortified soy foods may provide a useful substitute where athletes cannot consume dairy foods.

Three servings a day are required by adults, with an increased requirement during growth spurts in childhood and adolescence, and for pregnancy and lactation.

As with iron, it is recommended that women ingest more calcium than men, even though they generally eat less food. This means that female athletes must be more careful in the food choices that they make.

See the section on the female athlete for some suggestions of foods that are good sources of iron and calcium.



Supplements

The use of dietary supplements is widespread in sports, but athletes should not expect benefits from most of these supplements.

Athletes look to nutritional supplements for many benefits, including:

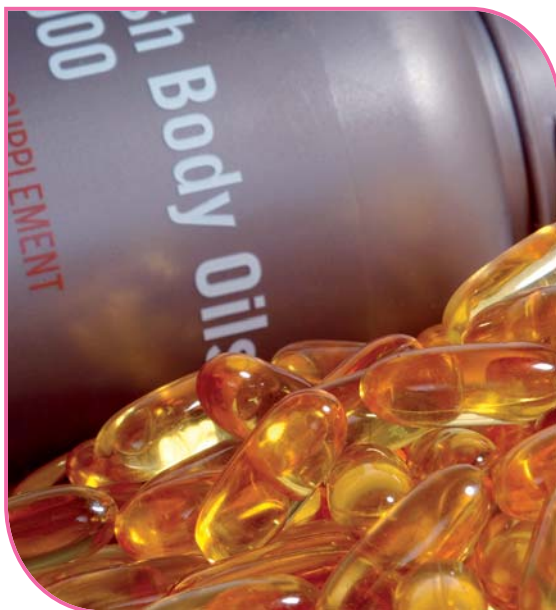
- ▶ promoting adaptations to training
- ▶ increasing energy supply
- ▶ allowing more consistent and intensive training by promoting recovery between training sessions
- ▶ maintaining good health and reducing interruptions to training due to chronic fatigue, illness or injury
- ▶ enhancing competitive performance.

Few of the products used by athletes are supported by a sound research base and some may even be harmful. All athletes should look carefully at the risks and rewards of individual supplements before trying them.

Where there is a demonstrated deficiency of an essential vitamin or mineral, and an increased intake from food is not possible, a supplement may be helpful as a short term solution. The use of supplements, however, does not compensate for poor food choices and an inadequate diet. Many athletes ignore the need for caution in supplement use, and take supplements in doses that are not necessary, and may even be harmful.

Protein powders and supplements

Protein supplements, high protein bars and amino acid preparations are among the biggest selling sports nutrition products. Although an adequate intake of protein is essential for muscle growth and repair, this can easily be achieved from everyday foods and extra protein is seldom required.



While protein supplements and protein-carbohydrate supplements may have a role as part of a post-exercise recovery plan, the whole proteins that are found in foods generally have advantages over individual amino acids.

Fat reduction and muscle building

A huge array of supplements is on sale with claims that they can reduce body fat levels and build bigger and stronger muscles – claims that appeal to athletes and non-athletes alike.

The reality is that many of the products that are effective in doing this either contain ingredients that are on the banned list and will lead to a positive drugs test or are associated with serious health risks (or both).

Compounds in the muscle building category include chromium, boron, hydroxymethylbutyrate, colostrum and others. Based on current research, none of these provides a substantial benefit to offer the athlete.



Increasing energy supply

Supplements in this category include pyruvate and ribose as well as some more exotic herbal preparations. None of these is likely to improve performance and, in spite of advertising claims, there is very limited good independent evidence.

Nutrition and the immune system

There is some evidence that athletes who are training hard or travelling and competing frequently may be at increased risk of minor illnesses and infections. These are generally trivial, but they can interrupt training or cause the athlete to miss important competitions. Hard training may compromise the body's immune system, and high levels of stress hormones reduce its ability to fight these infections.

Many nutrition supplements, including glutamine, zinc, Echinacea, colostrum and others, are on sale with claims that they can boost the immune system, but there is no strong evidence that any of these is particularly effective for athletes. The best way to support the immune system from a nutritional perspective is to look after the carbohydrate fuel needs of the training programme, since this lowers stress hormone levels. Of course, appropriate sleep, recovery and rest periods are also important for immune health.



Supplements for bone and joint health

Hard training puts extra wear and tear on the bones, joints and associated structures, and numerous supplements are claimed to look after these tissues.

Healthy bones need a good supply of calcium and Vitamin D. Calcium can be provided by a well-chosen diet, while Vitamin D comes from well-managed exposure to sunlight. We now recognise that there is a community health issue related to Vitamin D deficiency and insufficiency. Risk factors in athletes include living at latitudes greater than 35 degrees, training indoors, training in the early morning or late evening thus avoiding sunlight exposure, wearing protective clothing or sunscreen, and consuming a diet low in Vitamin D. Athletes with these characteristics or from other problems related to sub-optimal bone density should seek professional advice and supervised treatment from a sports physician.

Glucosamine, chondroitin, methylsulphonylmethane (MSM) and other products are promoted for joint health. Long-term (2-6 months) glucosamine treatment may provide subjective relief in some elderly individuals suffering from osteoarthritis, but there is little or no evidence of benefit for otherwise healthy athletes.

Supplements that might work

Some supplements do offer the prospect of improved performance: these include creatine, caffeine, buffering agents, and perhaps a very few others.



PART 1 | GENERAL PRINCIPLES

NUTRITION GOALS & EATING STRATEGIES

CREATINE. Creatine supplements can increase the amount of high-energy creatine phosphate stored in the muscles, and may improve performance in single or multiple sprints. It may also lead to a gain in muscle mass, which may be helpful for some athletes but harmful for others. As with all supplements, exceeding the maximum effective dose is not helpful. Creatine is normally found in meat and fish, but the doses used in supplementation protocols (10-20 g per day for 4-5 days to load, and 2-3 g per day for maintenance) are more than is found in normal foods. Creatine supplementation appears not to be harmful to health.

CAFFEINE. A small amount of caffeine (1-3 mg/kg) can help performance in prolonged exercise and may also be helpful in exercise of shorter duration. Such moderate doses can be found in everyday amounts of coffee, cola drinks and some sports products (e.g. gels). For example, 100 mg of caffeine is supplied by a small cup of brewed coffee or 750 ml of a cola drink. Larger doses of caffeine do not seem to be more effective, and may have negative outcomes such as over-arousal and poor sleep patterns after an event.

BUFFERING AGENTS. During very hard exercise, the muscles produce hydrogen ions along with lactate ("lactic acid"). This is both good (giving energy to allow hard efforts) and bad (causing pain and interfering with muscle function). In the same way that excess stomach acidity can be neutralised by taking bicarbonate, so buffering agents taken before

an event can counter the negative effects of the acidity associated with high intensity exercise. Bicarbonate supplements are widely used by athletes in high-intensity events lasting several minutes in which fatigue associated with excess acidity occurs. There is a real risk of gastrointestinal problems, however, and athletes should experiment in training to find a protocol that can be tolerated. Recently, β -alanine supplements have been shown to enhance muscle buffering by increasing its content of a di-peptide called carnosine. There is growing evidence that this can improve sprint performance in laboratory tests. We await more investigations of performance changes in well-trained athlete and field settings, as well as consideration of the long term safety of this supplement.

EMERGING SUPPLEMENTS. There is recent, but growing evidence of potential benefits from a few other supplements. Amongst these are carnitine and nitrate. Carnitine may enhance the oxidation of fat in endurance events, thus sparing the limited glycogen stores. Nitrate supplements seem to increase the efficiency of aerobic metabolism in the muscle, offering potential benefits to middle and long distance runners who rely heavily on aerobic metabolism. As with all supplements, however, caution is needed until the safety of these supplements are clearly established.

A recent paper has suggested that high intakes of carnitine (from supplements or from high intakes of meat) may increase the risk of cardiovascular disease.

A number of sports foods have been developed to supply a specific formulation of energy and nutrients in a form that is easy to consume. These can be valuable in allowing athletes to meet their special nutrition needs when everyday foods are unavailable or impractical to eat. This is most often the case just prior to, during, or after an exercise session. Examples of useful sports foods include:

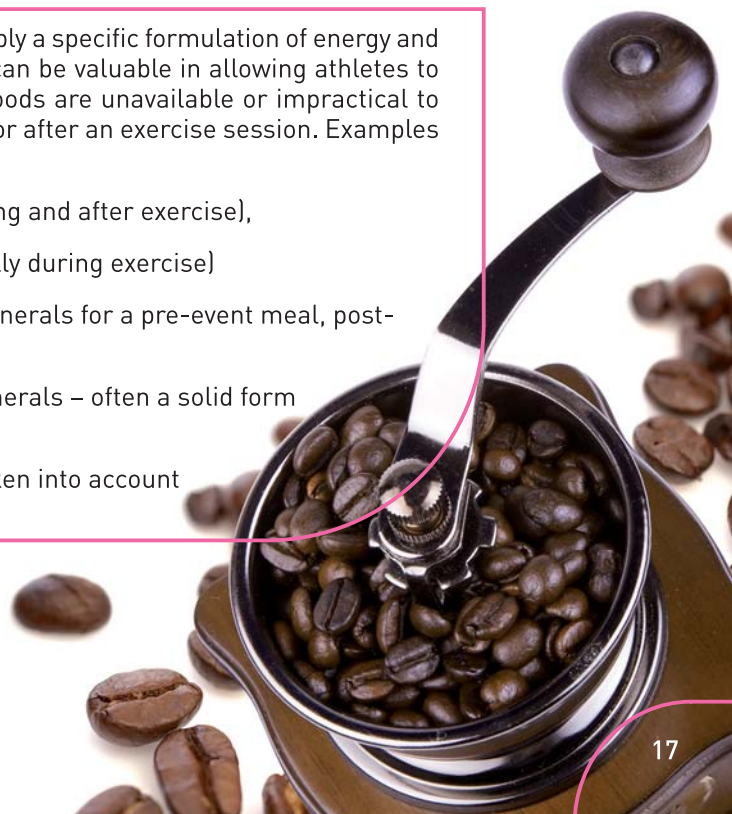
sports drinks (providing fluid and carbohydrate during and after exercise),

sports gels (additional carbohydrate intake, especially during exercise)

liquid meals (carbohydrate, protein, vitamins and minerals for a pre-event meal, post-exercise recovery or a high-energy diet)

sports bars (carbohydrate, protein, vitamins and minerals – often a solid form of the liquid meal)

Of course, the cost of these sports foods must be taken into account when deciding to use them.





Supplements and doping issues

Athletes who are liable for drug testing under national or international programmes should be especially cautious about supplement use.

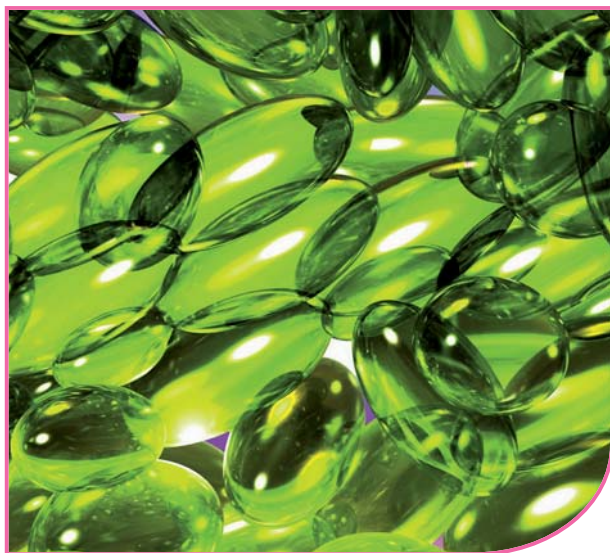
Some supplements are prepared in unhygienic conditions and contain toxins that may cause gastrointestinal problems. Others do not contain the dose of ingredients - especially the expensive ones - that is listed on the label. Contamination of dietary supplements with steroids, stimulants and other drugs that may cause an athlete to fail a doping test is widespread - some surveys have suggested that as many as one in four supplements may result in a positive test. These prohibited compounds have not been declared on the label, so there is no way for the athlete - or even for medical and other support staff - to know that they are present.

At present, there is no guarantee of the purity of any commercial supplement. The only way to be sure is to avoid supplements altogether, but many athletes are unwilling to accept this advice. The sensible

athlete will want to see very good reasons for using a supplement and a very low risk of an adverse test before deciding to use it. There are some programmes that test supplements for prohibited substances and can help athletes and those who advise them to manage the risks. Details of various national and international programmes should be available from national federations and anti-doping agencies.

There is no evidence that prohormones such as androstenedione and norandrostenedione are effective in enhancing muscle mass or strength. These prohormones are promoted for use by athletes and are readily available in shops and via the internet, but they will result in negative health consequences as well as positive drug tests.

Many herbal supplements are claimed to increase testosterone levels and hence have an anabolic action: such supplements include Tribulus Terrestris, Chrysin, Indole-3-Carbinol, Saw Palmetto, Gamma-oryzanol, Smilax and Mummio. These claims are based on experiments carried out in test tubes, and none has been shown to work in humans. All athletes are cautioned against the use of these supplements.



Athletes must be aware of the strict liability principle that makes them responsible for everything they eat and drink.

Ignorance is not an acceptable excuse for a positive doping result.

Check all supplements with a medical officer. If there is any doubt at all, don't take it.



Special needs of the young athlete

Athletics is a popular sport with children and adolescents around the world, offering the benefits of aerobic fitness, skill development and a team environment without the risks of a contact sport. Girls and boys can start practising and competing at an early age, though the focus should be on fun and on skills development rather than on performance. Nonetheless, most children are naturally competitive and it would be a mistake to suppress this instinct. Those with particular talent may progress to serious training and competition, but others continue for reasons of recreation, fitness or social contact.



Training issues

Depending on the age and calibre of the young athlete, “training” may range from the weekly school PE lesson to structured sessions at a local club. The goals of training may range from simply having fun through to a progressive programme aimed at developing the skills and specific fitness and physique required to progress to serious competition. Talented young athletes may be invited to train with another age group or with a senior squad, often in addition to their involvement with their age-group team.

Competition issues

For the youngest age groups, there should be no special need for any change to diet in the days before competition or on competition day itself. The main aims are to minimise the risk of gastrointestinal upset and to avoid problems of dehydration on hot days. It may be best to avoid solid food for 2-3 hours before competition – the combination of exercise and nerves can cause some gastric distress.

Children can often be out in the sun for many hours on sports days, and adults should be vigilant to ensure frequent application of sun cream and to be aware of any child who seems to be having problems. Ample fluid should be available, and children may need to be reminded to take small amounts of drinks at regular intervals.



Special issues and eating strategies:

- ▶ Parents are often roped in to become the coaches and trainers of age-group teams. They may accept these positions without an appreciation of the nutritional needs of athletics or young people, and without any resources to implement an effective training and diet programme. It is important that education resources are made available to these coaches so that they can guide young athletes into good habits.
- ▶ Athletes should be encouraged to develop good nutritional habits at an early age. Adolescence is a time marked by an increased independence in food choice and food preparation. The promise of sporting success may provide strong motivation to develop good dietary practices. Information and the example of good role models may help a young person to develop sound eating practices in everyday (training) diets as well as the specific preparation for competition.
- ▶ The physiology of children and adolescents differs from that of adults in several ways. The mechanisms of thermoregulation are less efficient in children, and special attention must be paid to the environment, activity patterns, clothing and hydration to avoid problems of hyperthermia or hypothermia.
- ▶ The growth spurts during childhood and adolescence require nutritional support in terms of adequate intake of energy, protein and minerals. Active young people may find it difficult to meet their needs for energy and nutrients when the costs of training and growth are added. Young people may not have developed the nutritional knowledge and time management skills to fit in all the eating occasions required to achieve high energy, nutrient-rich eating.
- ▶ The rate of obesity in children is still rising, but active youngsters do need a plentiful supply of energy from foods and energy-containing drinks.
- ▶ Many young athletes are eager to increase the rate of their growth and muscular development in pursuit of the physique of an adult. While growth and maturation are genetically determined, high-energy eating plans can assist the athlete to maximise the outcomes of growth and specialised training programmes.
- ▶ Young athletes eating a wide range of foods should not need to use dietary supplements, and athletes and coaches should be aware that these do not provide a short cut to success.

Ways to encourage good nutrition practices in children

- ▶ Encourage children to become involved in menu planning for the family meals, and for special needs associated with their training and competition sessions. Encourage positive messages that good eating practices, involving good choices of foods and drinks, are part of the formula for sporting success, and a healthy life.
- ▶ Children often need snacks to meet their energy needs over the day, and the special needs of recovery from sport. These snacks should involve nutrient-rich choices such as fruit, sandwiches, dried fruit and nuts, flavoured dairy products, and cereals and milk. Some planning is needed to have these choices on hand over the day, and before or after sport.



Special needs of the female athlete

General health issues

All female athletes should eat sufficient food to achieve an energy intake that:

- provides sufficient energy for training and competition needs
- the energy demands of other daily activities
- allows the athlete to achieve a body size and composition that meets her health and fitness goals

Some athletes do not achieve this, and restrict food intake to achieve their desired weight at the expense of both health and performance.

Losing body fat

There is enormous pressure on many women to achieve an unrealistic body weight and body fat level. This can compromise both short term athletic performance and long term health, with the real possibility of harm to reproductive health and to bone health. Any athlete with menstrual irregularities should treat these as a possible warning sign, and seek professional advice.

If there is a need to reduce body fat, this should be done sensibly. Reducing body fat requires a negative energy balance – energy expenditure should be greater than energy intake – and a negative body fat balance. It is a mistake to reduce energy intake – especially protein and carbohydrate intake – too far. This increases fatigue in training and daily life, reducing energy levels and thus limiting weight loss.

Strategies for reducing body fat

Set realistic targets: this is a medium-term goal rather than something to be achieved by next week.

Limit portion sizes at meals rather than skipping meals altogether.

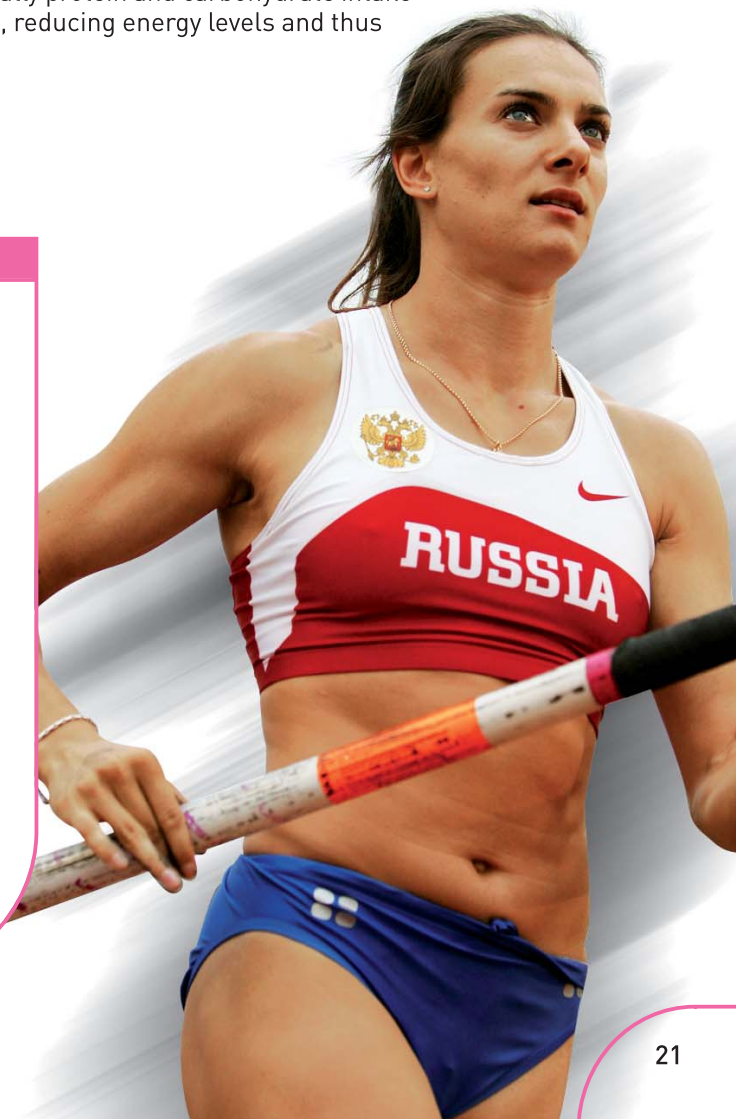
Use well-chosen snacks between meals to maintain fuel levels for training sessions. Save part of a meal for a later snack, rather than eating extra food.

Maintain carbohydrate intake to maintain fuel levels for exercise.

Use low-fat strategies in choosing foods and while cooking or preparing meals.

Limit alcohol intake or cut it out altogether – it is not an essential part of the diet.

Make meals and snacks more “filling” by including plenty of salads and vegetables, by taking the higher-fibre option, and by including low glycaemic index forms of carbohydrate-rich foods (e.g. oats, legumes, dense-grainy breads etc).





CALCIUM. Calcium is important for healthy bones. In some countries, many everyday foods are fortified with calcium (e.g. fruit juice). However, the best sources of calcium are dairy foods, with low fat varieties providing a great way to meet calcium needs within a smaller energy budget.

- Each athlete should aim to include at least 3 servings of dairy foods in their daily eating plans – e.g. 200 ml of low fat milk, 30 g cheese or a 200 ml carton of low fat yoghurt.
- Calcium-fortified soy versions of dairy foods are also suitable – e.g. soy milk, soy yoghurt.
- An additional one or-two daily servings are required during growth spurts in childhood and adolescence, and for pregnancy and when breast feeding.
- Fish eaten with bones (e.g. tinned salmon, sardines) and leafy green vegetables (e.g. broccoli, spinach) provide a useful source of additional dietary calcium.

IRON. Iron deficiency is a cause of fatigue and reduced performance. Females are particularly at risk because of increased iron requirements due to menstrual blood losses matched against a smaller intake of food. Iron-rich eating will help to reduce this risk.

IRON-RICH EATING

- Consume moderate servings of red meats (well-absorbed iron) in 3-5 meals per week.
- Choose iron-fortified cereal products such as breakfast cereals.
- Combine plant and non-meat sources of iron (e.g. legumes, cereals, eggs, green leafy vegetables) with food factors that enhance iron absorption. These include vitamin C and a factor found in meat/fish/chicken. Examples of clever matching include fruit juice or fruit with breakfast cereal, or chilli con carne (meat and beans).





PART 2

EVENT SPECIFIC NUTRITION

Sprints, Jumps, Throws and Multi-Events



Training issues

- ▶ The goal of many power and sprint athletes is to enhance muscle mass and strength through specially designed resistance training programmes. In most cases, these athletes believe that their food focus should be on protein intake. In fact, there is no evidence that very high intakes of protein (> 2 g per kg BM per day) are necessary or even advantageous for optimizing the results of resistance training. It is likely that the best results are achieved through enhanced recovery strategies such as providing a source of protein and carbohydrate immediately after the workout.
- ▶ Many power and sprint athletes forget to bring a drink bottle to training. However, workouts are best undertaken when the athlete is well-hydrated and well-fuelled. Fuelling with a sports drink can help the athlete to keep lifting or training with a good technique, right to the end of a long session.
- ▶ There are numerous supplements that are claimed to promote recovery, increase muscle mass, reduce body fat and enhance performance. These claims are attractive to all athletes, but seem particularly entwined with the world of body building and strength training. Many athletes are not aware that the claims made for most products are unsupported or exaggerated, and that the industry operates with little regulation.

Competition issues

- ▶ Most sprint events are conducted over a short time, with minimal impact on fluid and carbohydrate levels. However, competition can require the athlete to compete in a series of heats, semis and finals, or with long periods between rounds of a field event or multi-sport competition. This calls for special eating strategies to recover between events or to manage fluid and energy levels over a long day.

Eating strategies for power and strength athletes

- ▶ A key ingredient in a plan designed to enhance muscle size and strength is adequate energy intake. Energy should be supplied both by carbohydrate-rich foods that provide fuel for training as well as protein- and nutrient-rich foods that can provide building blocks for the results.
- ▶ Recent evidence suggests that enhanced effects on protein balance are achieved by following up a resistance workout with a meal or snack providing a good source of high-quality protein soon after the session.
- ▶ A few supplements and sports foods provide valuable benefits to the athlete's training and competition programme. It is important for the athlete to seek up-to-date and independent advice from a sports nutrition expert to identify these products and how to use them to suit the athlete's current programme, budget and performance goals.



- On the day of competition, the athlete should consume a comfortable pre-event meal, and organise appropriate carbohydrate-rich drinks and light snacks to stay fuelled and hydrated between events or bouts in a multi-event programme.
- Multi-event athletes should plan their meals and snacks carefully to suit the suggested timetable of each competition. It is useful to debrief after each competition to see what was actually consumed and how well this worked, so that the lessons can be transferred to future events.

Strategies for high-energy eating

- It is usually more efficient to increase the number of times that food is eaten each day – for example, a series of 5-9 meals and snacks – than trying simply to increase the size of meals.
- Drinks such as fruit smoothies, liquid meal supplements and fortified milkshakes and juices can provide a substantial source of energy and nutrients that are quick and compact to consume, and less likely to cause gastrointestinal discomfort than bulky foods.
- Sugary foods and specialised sports products (drinks, bars) can provide a compact form of carbohydrate and other nutrients, which is particularly useful when energy needs are high.
- A food record can identify the times in a busy day that aren't being well used for fuelling up. Athletes should use creative ideas and good planning to arrange a supply of portable snacks and drinks that can travel with them over their day.
- Adaptation to a resistance training programme may be enhanced by consuming "recovery" snacks providing protein and carbohydrate before and after each workout.

Food combinations supplying carbohydrate and protein



Breakfast cereal and milk
Sandwiches with meats, cheese or egg fillings
Meat/fish/chicken stir-fries served with rice or noodles
Fruit smoothies or liquid meal supplements
Canned tuna or salmon on crackers or rice cakes
Fruit and yoghurt
Dried fruit and nut mixes



PART 2

EVENT SPECIFIC NUTRITION

Middle distance running

The middle distance events cover races at distances from 800 m to 3,000 m, including the steeplechase. Middle distance runners face special challenges in training and competition, requiring a unique combination of speed and stamina.

Training issues for middle distance



Middle distance athletes implement a dynamic continuum in training volume, duration and intensity, which utilizes all energy producing pathways and muscle fibre types. At the centre of this periodised training regimen, should be a periodised nutritional approach that takes into account acute and seasonal nutritional needs induced by specific training loads.

As athletes progress through a season of training and racing, from the endurance development phase towards peak championship racing, the relative contribution of carbohydrate to energy supply increases, while fat-derived energy decreases. A large part of the training load normally consists of intense interval sessions, which place particularly high demands on the body's limited carbohydrate stores. The rate at which muscles use carbohydrate increases exponentially as the running speed increases, so a middle distance runner may use more muscle glycogen in an intense 30 min intervals session consisting of, say, 20 x 200 m with short recoveries, than a marathon runner uses in a two hour session. If there is another session later in the day, then recovery of the carbohydrate stores between sessions is a primary objective if training quality is to be maintained.

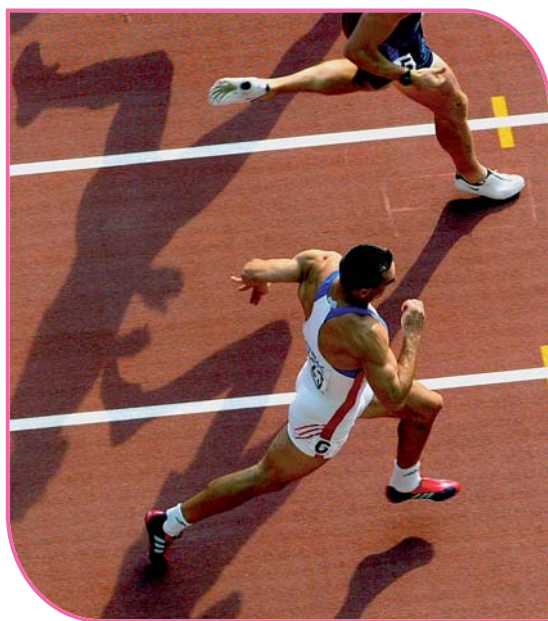
High-intensity training is also especially likely to cause gastrointestinal problems. Athletes are therefore often reluctant to eat for a couple of hours before training and may not want to eat anything for a couple of hours afterwards. When hard sessions are close together, with only a few hours of recovery between, it is important to eat soon after the first session if recovery is to be optimised. Athletes must therefore sometimes eat even when they do not feel hungry. Carbohydrate drinks and high-carbohydrate snacks or confectionery may be useful at this time to begin the refuelling process.

There is some evidence that middle distance athletes undertaking both endurance and resistance types of training should phase their daily exercise with at least several hours of recovery between the two differing stimuli.

More research is needed to better characterize the adaptations induced by concurrent training before any definite advice can be given. The evidence is very clear that eating some protein and carbohydrate soon after resistance training has potential benefits for promoting adaptations to training, but it is less clear that this also applies to other types of training.



A high aerobic capacity is especially important to middle distance runners: the $VO_{2\max}$ of the top middle distance runners is higher than that of the top marathoners. Iron stores are therefore vitally important, and athletes should ensure an adequate intake of iron by eating red meat, liver or seafood at least 2-3 times per week. If this is not possible, then a regular intake of iron-fortified breakfast cereals and green leafy vegetables is advised.



Competition issues for middle distance

Although it is not clear that carbohydrate-loading will benefit the middle distance runner as it does the endurance athlete, it is very clear that an athlete who begins racing with low muscle glycogen will not perform well. They may be OK for the first part of the race, but will be found wanting when the pace picks up towards the end.

Supplementation of sodium bicarbonate and β -alanine may augment intra- and extracellular buffering capacities, which may in turn lead to a small, but significant, increase in performance. Although highly individual, data show that a given ingestion of 0.3 g of either sodium bicarbonate or citrate per kg of body weight administered approximately 1 to 3 hours prior to exercise may offer a small but very real benefit. There is some risk that taking large amounts of these buffering agents will cause vomiting or diarrhoea in some athletes and should be experimented with in training rather than in competition. The optimal protocols for loading and maintaining muscle carnosine levels with β -alanine supplements are currently being investigated but will involve a chronic protocol over at least 6 weeks, with daily intakes of ~ 2-4 g.



PART 2

EVENT SPECIFIC NUTRITION

Distance running and race walking

Training issues for distance events

A demanding endurance training programme usually involves daily or twice daily workouts. Inadequate refuelling leads to fatigue and ineffective training. Low body fat levels may benefit performance, and are pursued obsessively by some distance runners and walkers. Severe restriction of energy intake and dietary variety can lead to fatigue, nutritional deficiencies, hormonal imbalances and disordered eating. Lengthy, high-intensity workouts lead to high sweat losses, particularly in hot weather. Requirements for protein, vitamins and minerals may also be increased by a heavy training load.

Competition issues for distance events

The main factors causing fatigue during competition are fuel (carbohydrate) depletion and dehydration. Strategies for eating before, during and after the event are important to reduce these effects. Competition is often undertaken in multiple stages, or as a series of heats and finals. Recovery between sessions can be important in determining the final winner.

Eating strategies for the distance runner or walker

- ▶ When carbohydrate intake targets are high, meals and snacks should be based around nutritious carbohydrate-rich foods such as breads, rice, pasta, noodles and other grain foods, fruits and starchy vegetables, legumes, and flavoured dairy foods. The addition of protein-rich foods and vegetables to meals will help to balance fuel needs and other nutrition goals.
- ▶ Sugary foods and drinks provide a compact form of carbohydrate, which is particularly useful when energy needs are high or in situations when it is impractical to eat bulky foods. Drinks providing carbohydrate (sports drinks, soft drinks, juices, fruit smoothies, and milkshakes) also provide a compact way to refuel.



- ▶ Key strategies to achieve lighter and leaner physiques include low-fat eating, and attention to portion sizes.
- ▶ Endurance athletes with very high energy needs may find it valuable to spread their daily food intake over a series of meals and snacks. Even when energy intakes are modest, well-placed snacks may help prevent hunger and energy drain over the day, ensure adequate fuel for workouts, and prevent overeating at the next meal.
- ▶ Fluid and fuel replacement are key issues during most competitive events, and the athlete should prepare for competition by fuelling up in the day(s) leading up to the event and ensuring that they are well-hydrated. For marathons and 20/50 km race walking events, many athletes carbohydrate load, by tapering their training and increasing carbohydrate intake for 2-3 days prior to the race (see box).

- The pre-race meal offers a final way to top-up fuel and fluid levels, and menu choices should be based around carbohydrate-rich eating. The ideal amount and type of foods and drinks, and the timing of this meal, will vary between athletes and should be fine-tuned with experience to avoid gastrointestinal disturbances during the race.
- In running events of half-marathon and over, or in race walking events of 10 km or more, there is an opportunity to refuel and rehydrate "on the run". Each athlete should develop a fluid intake plan based on knowledge of expected sweat losses and how much of this loss is practicable to replace. Fluid intake should not exceed sweat losses. In events of approximately ~ 60 min or more, it is likely that carbohydrate intake will provide fuel for the muscle or brain and improve performance. New information has provided different recommendations according to the length of the event. Sports drinks, gels, confectionary and other everyday foods/drinks may be used in a fuelling plan. Race day strategies should be tried in training, both to enhance the session and to fine-tune the competition plan.
- After a race or workout, the athlete should eat and drink to promote quick recovery. Light and portable recovery snacks are a useful choice until the normal meal pattern is resumed.

Fuel suggestions for running/walking events		
Duration	Target	Comments
< 45 min	Not needed	
45-75 min	Frequent mouth swishing of small amounts of a carbohydrate drink	New evidence shows that receptors in the mouth and throat communicate with the brain to let it know that fuel is on the way. Even if the carbohydrate isn't swallowed, the brain will feel better and choose a faster pace
1-2 h	Up to 30 g/h	
2-3 h	30-60 g/h	Providing muscle fuel becomes more important as the race becomes longer
> 3 h	Up to 60-90 g/h	To achieve these amounts, special drink blends with glucose + fructose may be needed. Drinking these during workouts may train the gut to become better at absorbing fuels



Carbohydrate choices for race fuel

30 g carbohydrate is provided by:

- 400-500 ml of a sports drink
- 250 ml of a defizzed soft drink
- ~1 packet sports gel
- ~ sports bar
- 1 large or 2 small bananas
- 1 thick slice of bread and jam/honey
- 35-40 g candy/confectionery

A sample of a carbohydrate loading menu for 1 day for a 65 kg male runner*
(650 g carbohydrate or 10 g/kg)

Breakfast: 2 cups of flake cereal + cup milk + banana
250 ml of sweetened fruit juice

Snack: 500 ml bottle soft drink
2 slices of thick toast + jam

Lunch: 2 large bread rolls with fillings
200 g of flavoured yogurt

Snack: Coffee scroll or muffin
250 ml of sweetened fruit juice

Dinner: 3 cups of cooked pasta
+ 3/4 cup sauce, 2 cups of Jelly/Jello

Snack: 2 crumpets and honey
250 ml of sweetened fruit juice

*The menu focuses on the carbohydrate-rich foods; other foods can be added to balance the meal. An exercise taper should accompany this menu to optimize muscle glycogen storage. Distance runners or walkers of different sizes should scale the carbohydrate up or down according to their body weight



Practical challenges to achieving nutrition goals

As highlighted earlier in this booklet, there may be many challenges that athletes must overcome to ensure that their diet meets their requirements.

We are not good at teaching young people about food and nutrition, and a combination of poor knowledge about foods and inadequate cooking skills means that many young people are not well equipped to make good food choices.

Young athletes are always busy, with training, studies, work and other commitments to fit in, leaving little time for food shopping and preparation.

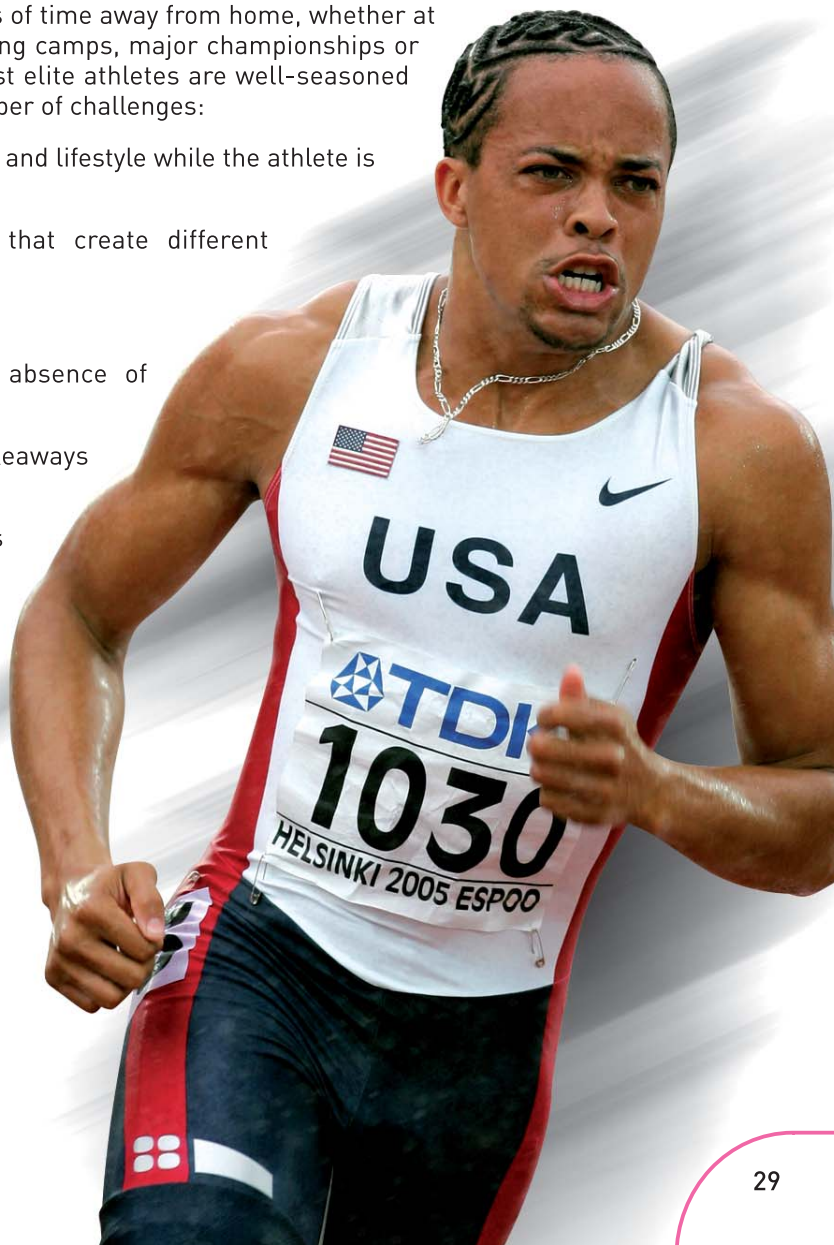
These are poor excuses, however. The serious athlete will realise how important nutrition is – it makes no sense to train hard and throw all that effort away by making poor food choices.

A little planning, and perhaps an injection of advice from a sports nutrition professional, is all that most athletes will need to be self-sufficient.

Eating strategies for the travelling athlete

Today's elite athletes often spend long periods of time away from home, whether at altitude training camps, warm weather training camps, major championships or just travelling on the competition circuit. Most elite athletes are well-seasoned travellers, but frequent travel can pose a number of challenges:

- ▶ Disruptions to the normal training routine and lifestyle while the athlete is en route
- ▶ Changes in climate and environment that create different nutritional needs
- ▶ Jet lag
- ▶ Changes to food availability including absence of important and familiar foods
- ▶ Reliance on hotels, restaurants and takeaways instead of home cooking
- ▶ Exposure to new foods and eating cultures
- ▶ Temptations of an "all you can eat" dining hall in an Athletes' Village
- ▶ Risk of gastrointestinal illnesses due to exposure to food and water with poor hygiene standards
- ▶ Excitement and distraction of a new environment





The keys to eating well while travelling are:

1. Planning ahead

Investigate food patterns and availability at your destination before you leave home. This may help you to plan useful food supplies to take on your travels that can replace missing and important items.

Contact the catering organisers at your destination to let them know of your needs for meal timing and menus.

- Make an eating plan for travel that incorporates the best of the available food supplies (e.g. airline catering, restaurants en route) as well as self-supplied snacks.

2. Eat and drink well while on the move

Recognise that enforced rest while travelling will reduce energy needs, but create more opportunities for high energy intake if the athlete succumbs to “boredom eating”. Be aware of eating to real need. When moving to a new time zone, adopt eating patterns that suit your destination as soon as the trip starts. This will help to adapt your body clock. Be aware of unseen fluid losses in air conditioned vehicles and pressurised plane cabins. Have a drink plan that keeps you well hydrated.

3. Be wary of food and water hygiene

Find out whether it is safe to drink the local water supply. If risky, stick to sealed bottles of water and other drinks or hot drinks. Be wary of ice added to drinks – it is often made from tap water. In high-risk environments stick to food produced in good hotels or well-known restaurants. Avoid eating food from local stalls and markets, however tempting it is to have an “authentic cultural experience”. Stick to food that has been well-cooked, and avoid salads or unpeeled fruit that has been in contact with local water or soil.



4. Choose well from local cuisine and supplement with non-perishable food supplies brought from home

Some ideas for portable supplies for travelling athletes include:

- Breakfast cereal and powdered milk
- Cereal and breakfast bars
- Rice cakes
- Spreads – honey, jam, peanut butter
- Powdered sports drinks and liquid meal supplements
- Sports bars
- Dried fruit and nuts

5. Use clever tactics in restaurants, all you can eat dining halls and when choosing takeaways

Stick to an eating plan based on what is normally eaten at home, or what meets new nutritional needs, rather than being mesmerised by all the food on offer. Be assertive in asking for foods to be prepared to your needs – for example, with low-fat cooking methods, or with an added carbohydrate serving. Avoid hanging around in restaurants or dining halls for entertainment – it can often lead to unplanned and unnecessary eating.

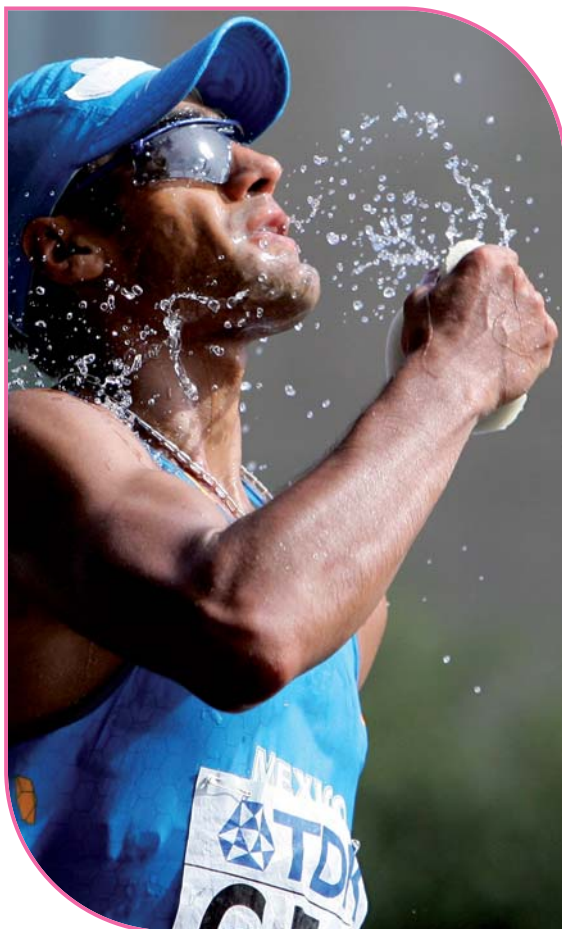
- Remember that your normal eating patterns probably involve well-timed and well-chosen snacks. If your new catering arrangements provide only for main meals, ensure that the menu at meals includes some items that can be taken away for snack needs.



Environmental challenges

Athletes train and compete in every country of the world, and they may face a number of different environmental challenges at home or when they travel for competition. The athlete who trains in winter in Russia or the American mid-West is confronted with wind, snow and bitter cold, while the Saudi Arabian athlete who trains in mid-summer may face temperatures of 50°C and high humidity. In every case, however, athletes learn to cope and it is often a matter of pride never to miss a session because of adverse weather conditions.

Athletes are sometimes required to compete in environments that are very different from those they are accustomed to at home, and this can pose special challenges. Every challenge, though, should be seen as an opportunity, and nutritional strategies can be adopted to help athletes cope with environmental extremes.



Special issues for exercise in hot climates

Most athletes - especially sprinters and field events athletes - enjoy opportunities for warm-weather training and competitions, but these can be challenging for all athletes, including especially the endurance athletes.

Those who normally live in cold climates will benefit from a period of heat acclimation before competing in major events held in a hot climate. It is also essential for these athletes to gain heat experience so that they know how to adapt training and competition strategies, as well as drinking behaviours and lifestyle factors when they are suddenly exposed to hot weather.

Heat acclimation is achieved best by 60-100 minutes of modest exercise in warm environment: about 10-12 sessions at intervals of not more than 2-3 days will achieve this.

Athletes not used to hot weather must be aware of the need to make some changes to their routine:

- ▶ It may be necessary to modify the warm-up and reduce the amount of clothing worn to prevent over-heating and excess sweat loss before competition begins.
- ▶ Extra fluids may be necessary, and cool fluids may be especially welcome, so insulated drinks bottles can help.
- ▶ Sports drinks contain calories: too much can upset the athlete's energy balance, so this must be part of the overall eating plan.



Special issues for exercise in cold climates

- ▶ In cold weather, many athletes forget about their fluid needs thinking that their sweat needs are minimal. In fact, sweat losses can be substantial during hard training, and may cause some impairment of performance especially if allowed to accumulate over a number of sessions. It can be useful for athletes involved in high-intensity sessions to monitor their fluid losses during training and events to gauge true fluid needs and their success in meeting them.
- ▶ Fluid intake during exercise also provides an opportunity for fuel intake – for example, sports drinks containing 6-8% carbohydrate composition are typically able to meet the fuel and fluid needs of warm-weather sports simultaneously. However, in cold climates, fuel needs during an event will generally be maintained while fluid needs are lower than when the same event is undertaken in a hot environment. Therefore, many athletes refuel with more concentrated carbohydrate drinks – sometimes up to 25% concentration – or add carbohydrate gels and solid foods to the event menu. Experimentation in training will help the athlete develop a successful competition day programme.

- ▶ Movement on snow and ice is more complex than running over ground, and has a greater risk of injury and accidents. There is some evidence that a fatigued athlete is at greater risk of these problems, and the athlete training on ice or snow should take a pro-active role in maintaining fluid and fuel status during prolonged workouts or during periods of intensive training. If the training venue is in a wilderness area, some creativity may be required to ensure that an adequate supply of foods and fluids are available for speedy recovery after the workout.

Special issues for exercise at moderate altitudes

- ▶ The cold and dry conditions at moderate altitudes cause an increase in water losses during breathing. This can lead to a substantial increase in fluid losses at moderate altitude compared with sea level. The athlete should take additional care to check fluid status over the day and during exercise sessions when they move to a higher altitude, since habitual drinking patterns may need to be adjusted to keep pace with these losses.
- ▶ There is an increase in carbohydrate use during exercise at altitude, making it more important to be aggressive with refuelling strategies during a workout, and over the day.
- ▶ Since a move to a higher altitude may increase oxidative damage during exercise, and promote adaptive response to increase erythropoiesis (red blood cell production), athletes should ensure that their diet is rich in fruits and vegetables to provide essential anti-oxidants, and in iron-rich foods. It may be worth checking iron status by way of a blood test before going to altitude.



PART 3

EATING STRATEGIES

Cultural and regional issues

An infinite variety of different food combinations can be chosen by athletes to meet their nutritional goals. All the essential nutrients can be obtained from normal foods, and variety is a key to meeting nutrient needs, but many different foods can be interchanged. Good sources of carbohydrate may be bread, rice, pasta, potato, couscous, or the maize porridge favoured by many Kenyan athletes. Protein will be provided by many different foods; the obvious foods are meat, fish, eggs and dairy produce, but bread, cereals, pasta, lentils and beans are only a few of the other excellent sources of protein. The fruits and vegetables that are commonly available will differ from region to region, although many staples or favourites are exported around the globe. Our eating habits are much more international than they were, and athletes can enjoy foods from different countries of the world.

Some athletes – more often those in endurance events, and perhaps also more often female athletes – adopt a vegetarian lifestyle, and this is in no way incompatible with success in sport. It does mean, however, that athletes must be more aware of the

food choices that they make. If there are no animal foods in the diet, then a Vitamin B12 supplement may be necessary. Avoiding red meat means that special attention must be paid to ensuring that the diet contains enough iron from plant sources, combined with other foods that aid iron absorption: for example, iron-fortified breakfast cereals, consumed at a meal containing Vitamin C (a glass of orange juice). Dairy produce should be included in the diet to ensure an adequate calcium intake, but calcium-fortified foods are also available.

There may be special circumstances that cause athletes to change their normal training and dietary habits. Muslims should avoid food and fluid intake during daylight hours during the holy month of Ramadan. This can mean changes to training times, especially in very hot weather, to ensure that adequate hydration is maintained. Where athletes must compete during Ramadan, they should be aware that prior preparation is necessary to ensure good liver and muscle glycogen stores and good hydration. Performance will not necessarily suffer if the athlete is well prepared.





References for further reading

NUTRITION FOR ATHLETES is based on information discussed at the IAAF Consensus Conference on Nutrition for Athletics, held in Monaco on 18-20 April 2007. The papers presented at that meeting were published as a Special Issue of the Journal of Sports Sciences in 2007.



Nutrition for sprints

Kevin Tipton, Asker Jeukendrup and Peter Hespel

Nutrition for middle distance running

Trent Stellingwerff, Peter Res, Mike Boit

Nutrition for distance events

Louise Burke, Mark Tarnopolsky and Greg Millet

Nutrition for jumps, throws, multi-events

Linda Houtkooper and Myra Nimmo

Physique & performance in track and field

Helen O'Connor and Tim Olds

The female athlete triad

Melinda Manore and Anne Loucks

Nutrition for the young athlete

Flavia Meyer, Helen O'Connor and Susan Shirreffs

Fluid needs for training and competition

Susan Shirreffs, Robert Carter and Doug Casa (US)

Fatigue and illness in athletes

Myra Nimmo and Bjorn Ekblom

The use of dietary supplements by athletes

Ron Maughan, Hans Geyer and Frederic Depiesse

Innovations in training and nutrition

John Hawley, Marty Gibala and Stephane Bermon

Nutrition for travel

Tom Reilly, Jim Waterhouse, Louise Burke and Juan Manuel Alonso



PART 3

EATING STRATEGIES

Nutrition for athletics. The 2007 consensus statement of the IAAF

Athletics consists of a range of events requiring varying inputs of technique, strength, power, speed and endurance. Well chosen foods will help athletes train hard, reduce risk of illness and injury, and achieve performance goals, regardless of the diversity of events, environments, nationality and level of competitors. General recommendations can be made, but these should be implemented on an individual basis, according to the athlete's stage of maturation, sex, periodisation phase, training programme and competition goals. A qualified sports nutrition professional can help athletes find practical ways to achieve their nutrition goals despite a busy lifestyle, gastrointestinal issues and the challenges of travel. Appetite and thirst are not always good indicators of energy and fluid needs, and athletes will benefit from a personalised eating and drinking plan.

Athletes should consume a wide variety of foods that meet their energy needs and provide optimum amounts of carbohydrate, protein, fat, vitamins, minerals and other important food components. The energy requirements of training vary according to the type and duration of sessions which in turn change across training cycles. Some athletes naturally achieve their ideal physique as a result of heredity and training, but others must manipulate energy and nutrient intake to achieve desired changes in lean mass and body fat. Energy-restricted diets require careful selection of nutrient-dense foods to ensure that nutrient needs are met. Low energy availability should be avoided, as it can impair performance and adaptation to training as well as being harmful to reproductive, metabolic and immune function, and bone health.

An adequate carbohydrate intake is necessary to support intensive and consistent training with lowered risk of illness and injury. Guidelines for daily intakes are about 5-7 grams per kg body mass during periods of moderate training up to about 10 g/kg during heavy training or fuelling up for competition. Protein intake should be sufficient to optimise adaptation to both strength and endurance training,

but intakes of more than 1.7 g/kg/d are not necessary for any athlete. Strategic timing of meals or snacks that provide these macronutrients around training sessions may help to optimise fuel availability, promote adaptation to training and enhance recovery.

Preparation for competition should include strategies to ensure muscle fuel stores that are appropriate to the event. Carbohydrate intake during exercise can be of value for events lasting longer than about 1 h, and refuelling between events on the same day is important. Each athlete should develop a competition plan that is practical and provides benefits for their performance. Carbohydrate loading is beneficial for prolonged events and can be achieved by 2-3 d of high carbohydrate intake and training taper. A depletion phase or fat adaptation is not necessary.

Athletes should also have an individualised hydration strategy for training and competition. They should start appropriately hydrated and consider the need





and opportunity to consume fluid during and between activities. Generally, an athlete's fluid plan should limit total fluid deficits to less than about 2% of body mass, particularly when competing in a hot environment. Unless previously dehydrated, athletes should not over-drink before or during exercise such that they gain weight. Hyperhydration may detract from performance in weight-sensitive events and may lead to the serious problem of hyponatraemia. Rehydration after training or competition requires replacement of both water and salts lost in sweat.

Athletes must respond to changes in needs for energy, nutrients and fluid in new situations such as hot or cold environments, altitude and travel across time zones. Travel requires planning to cope with effects of the journey, different food cultures, changed access to foods and the risk of gastrointestinal disturbances. Youth athletes and their parents and coaches should be aware of the importance of nutrition for optimising health, growth

and performance. Youth athletes may need special education, encouragement or supervision to achieve appropriate energy intake, fluid needs related to exercise, and adoption of nutrient-rich meal patterns.

When everyday foods are impractical, specialised foods can help athletes achieve nutrition goals. Supplements do not compensate for poor food choices. Some supplements may benefit performance, but athletes are cautioned against the use of these products without first conducting an individual risk-benefit analysis. Athletes are advised to seek assurances regarding quality control of supplement manufacture to ensure freedom from contamination with toxic or doping substances. Supplements should not be used by youth athletes except where clinically indicated and monitored.

Good food choices will contribute to success in athletics and to health and enjoyment of life.

► Updated May 2013

The International Olympic Committee supported a 3rd consensus meeting on Nutrition for Sport, held in October 2010 in Lausanne. The consensus statement can be found at <http://www.olympic.org/Documents/Reports/EN/CONSENSUS-FINAL-v8-en.pdf>. The papers supporting this statement are published in a 2011 supplement to the Journal of Sports Science.





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