

# Chapter 11: Nutrition for sport

by Gary Slater

It is important for a coach to recognise that what athletes eat and drink will have an impact on their sports performance. A coach has regular contact with athletes, and it is only natural that they look to their coach as a valuable source of information on a wide range of issues, including diet. Therefore, the coach should understand key sports nutrition principles and know where to go if they want further information. It is also important to have an appreciation of factors that can influence the dietary intake of athletes, including their:

- . cooking and shopping skills (or those of their parents)
- . dietary practices and knowledge of significant others, including family, friends, teammates and flatmates
- . study and/or work commitments
- . financial stability
- . travel commitments.

The importance of nutrition for sports performance will vary depending on the sport, but it is fair to say that all athletes will benefit to some degree by considering their diet. Eating to optimise performance does not just happen; it takes a certain amount of knowledge, hands-on skill and commitment. However, it is not about athletes avoiding all of their favourite foods. There are no good and bad foods — all foods can be incorporated into an athlete's meal plan. It is a case of getting the proportions right for each individual. Sports nutrition focuses on providing an athlete with the fuel they need and uses their food preferences to achieve this. This chapter provides a general overview of the important ingredients in a well-planned diet for an athlete. It is not intended to be complete or replace the expert knowledge of a sports dietitian.

## Nutritional demands of exercise: the training diet

No one, magic food exists with all of the nutrients the body needs in the correct proportions. Rather, athletes should select a wide variety of foods from each of the food types, such as vegetables, fruit, cereals and grains, legumes, meat, fish and dairy foods. Variety also means the range of foods within each of these types (for example, cereals could be wheat, oats or rice). A variety of foods are encouraged because the nutritional benefits can be very different

between each food type. In fact, some nutrition authorities suggest we should eat at least 30 different foods each day. Eating a greater variety of foods each day ensures a greater variety of nutrients in your diet, including those we know about and those yet to be discovered.

Regular exercise increases demands on the body's energy supplies and fluid reserves. Meeting this increased demand is a high priority for hard-training athletes. High-energy expenditures during training dictate the need for higher-energy meal plans. While this might sound easy, an over-committed lifestyle with training, work, study and family commitments can limit opportunities to meet total energy requirements, demanding novel strategies to overcome such obstacles for each athlete. The following sections focus on the key energy-providing nutrients in an athlete's meal plan — carbohydrate, protein and fat.

## Carbohydrate

As carbohydrate is the main fuel burnt during exercise, focusing on a carbohydrate-rich meal plan can help build fuel reserves, delay fatigue, enhance recovery between sessions and maintain immune function. The harder and longer an athlete trains, the higher their carbohydrate needs. As such, carbohydrate needs will vary from day to day according to the intensity, duration and frequency of training sessions. Carbohydrate intake should be highest on heavy loading days and lower on recovery days. Table 11.1 provides a guide to daily carbohydrate needs. However, these recommendations need to be balanced against total energy needs over the day and the requirement for other nutrients.

**Table 11.1: Daily carbohydrate requirements**

Exercise load per day	Carbohydrate intake (grams per kilogram per day)
Light (< 1 hour)	3–4
Light to moderate (1 hour)	4–5
Moderate (1–2 hours)	5–6
Moderate to heavy (2–4 hours)	7–10
Heavy (4–5 hours)	10–12 <sup>+</sup>

Selecting nutritious carbohydrate-rich foods such as wholegrain bread and other flour-based products, cereals, pasta, rice, noodles, fruit in all its forms, legumes, starchy vegetables (for example, potato and corn), and low-fat dairy products, not only assists in achieving carbohydrate needs but also provides essential nutrients. As such, wholegrain and less-processed carbohydrate-rich foods are generally considered to be nutrient dense, contributing a large part to daily vitamin, mineral and fibre intake.

### Case study

Julia coaches a group of high school female rowers who typically train three to four mornings a week during school term. During a mid-term break a training camp is held in preparation for a major regatta in two months. With two daily training sessions, several of the girls complain of fatigue and tiredness after the morning row on the third day. Recognising that training volumes have doubled those usually experienced during the school term, Julia quizzes the athletes about their dietary intake.

Despite the increase in training load, few athletes have increased their carbohydrate intake, indicating that the frequent training sessions often coincide with snack times, meaning the athletes are only eating three or four times a day. Julia instructs the girls to make use of sports drinks during training sessions and to bring compact carbohydrate-rich snacks with them (for example, cereal bars, fruit yoghurt, dried fruit and fruit bread) for recovery snacks immediately after getting off the water. Combined with a lighter afternoon training session, the boost in carbohydrate intake helped the girls get through the training camp and compete successfully at the regatta.

Many carbohydrate-rich foods are also a valuable source of protein. Consequently, carbohydrate-rich foods should form a significant part of each and every meal/snack. Having an appreciation of the carbohydrate content of foods can make it easier to compare daily carbohydrate intake against recommendations. Table 11.2 provides a list of carbohydrate-rich foods and the amount of each food required to obtain 30 grams of carbohydrate.

**Table 11.2: Carbohydrate-rich foods**

Food/fluid	Serve	Food/fluid	Serve
<b>Nutritious carbohydrate foods</b>		Dried fruit	½ cup
Rice	½ cup	Milk**	2½ cups

Noodles/pasta	⅔ cup	Yoghurt (fruit)**	200 grams
Bread/fruit loaf	2 slices	Fruit juice	1½ cups
Bread roll	1 medium	<b>Refined carbohydrate foods</b>	
Crumpet	1½	Jam/honey/syrup	2 tablespoons
Muffin (English)	1	Sugar	1½ tablespoons
Muffin (baked)	½ large	Chocolate*	50 grams
Rice cakes	3 slices	Ice cream*	6 scoops
Potato	2 medium	Potato chips*	1 cup
Corn	1 cup	Jubes/jelly beans	50 grams
Breakfast biscuit	3 biscuits	Jelly	¾ cup
Flake and fruit cereal	1 cup	Soft drink	1 can (335millilitres)
Oats (cooked)	1½ cups	Cordial	1½ cups
Kidney/baked beans	1 cup	Ice block	2
Cereal bar	1 bar	<b>Sports nutrition supplements</b>	
Muesli bar*	1½ bars	Sports drink	2 cups
Fruit salad	2 cups	Carbohydrate gel	1
Apple/pear	2 medium	High carbohydrate drinks	⅔ cup
Orange/mandarin	2 large	Sports bar	⅔ bar
Banana	1 medium	Carbohydrate loader powder	1½ tablespoons

\* Higher fat — not recommended as a first choice carbohydrate source

\*\* Preference for low-fat varieties

Source: Australian Department of Community Services and Health 1995

## Tips for achieving a high-carbohydrate diet

- . All meals and snacks should be based on nutritious carbohydrate-rich foods such as noodles, rice, pasta, bread and other flour-based foods, cereals, fruit in all its forms, legumes and starchy vegetables. These foods should take up half of the plate during heavy loading days.
- . Vegetables are very nutritious, but only potato and corn contain significant amounts of carbohydrate. Thus, vegetable-based dishes should be accompanied by some carbohydrate-rich food (for example, rice, noodles and bread) at a meal.
- . Carbohydrate-rich snacks should be included in the meal plan each day. It can be very difficult to achieve carbohydrate requirements from just three meals a day. Snacks such as sandwiches, fruit bread, cereal bars, fruit yoghurts, fresh and dried fruit, low-fat fruit smoothies, pancakes and scones are excellent choices.
- . Including small serves of refined carbohydrate foods such as jam and honey can be an easy way of boosting carbohydrate intake for those with very high carbohydrate needs. As a very concentrated source of carbohydrate, these foods can increase total carbohydrate intake without adding to the bulk of a meal.
- . Sports drinks should be used during intensive sessions lasting longer than 60–90 minutes, depending on the intensity of the session. They help to meet both fluid and carbohydrate needs simultaneously.

**Note:** The Australian Institute of Sport has investigated the relative benefits and potential concerns associated with the use of sports drinks. Visit the AIS Sports Nutrition website ([www.ais.org.au/nutrition/documents/SupSportsDrink07.pdf](http://www.ais.org.au/nutrition/documents/SupSportsDrink07.pdf)) for further information.

## Protein

It was previously a common belief that protein was the major fuel used during exercise. We now know that carbohydrate and fat are our main energy sources; however, protein still plays many essential roles in the body. Each protein is made up of differing combinations of amino acids. In fact, our dietary requirement for protein is actually a need for amino acids. Twenty amino acids make up all of the proteins in our diet. Nine of these are essential; the body cannot make them, so they must come from the diet. Protein from animal food contains all the essential amino

acids, while plant protein does not. Choosing a wide variety of protein-containing food ensures both vegetarians and non-vegetarians obtain adequate amounts of essential amino acids. While meat, seafood, poultry and dairy foods are especially good sources of protein, many plant foods also contain moderate amounts of protein and can contribute significantly to total daily protein intake. Table 11.3 shows the dietary sources of protein, including both animal and plant foods. Each serve contains 10 grams of protein.

**Table 11.3: Dietary sources of protein**

Animal	Plant
30–35 grams beef/lamb/chicken/pork	2 cups rice (cooked)
50 grams fish	2 cups noodles/pasta (cooked)
2 medium eggs	120 grams tofu
Glass milk/soy milk	4 slices bread
2 slices of cheese	2 cups breakfast cereal
200 gram yoghurt	$\frac{3}{4}$ cup baked beans/lentils
$\frac{1}{4}$ cup cottage cheese	$\frac{1}{3}$ cup nuts
$\frac{1}{2}$ cup liquid meal supplement	2 slices fruit bread

Athletes obtaining their protein from purely plant sources should consume a variety of the foods listed in Table 11.3 each day to ensure that they obtain all necessary amino acids.

Muscle protein is constantly being made and broken down. Some of this protein is recycled in the body while the remainder must come from the diet. The recommended dietary intake for protein in the general population is 46 grams for females and 64 grams for males, or ~0.8–1 grams per kilogram of body weight daily. Both strength and endurance athletes have greater protein needs than inactive people (upwards of 50–100 per cent more), depending on the training undertaken and training status of the athlete (see Table 11.4).

**Table 11.4: Daily protein requirements of athletes**

Population	Estimated protein needs for males (grams per
------------	--

kilogram per day)	
Recreationally active	0.8–1.0
Resistance training (inexperienced athlete)	1.5–1.7
Resistance training (experienced athlete)	1.0–1.2
Endurance training	1.2–1.6
Adolescent athlete	1.5–2.0
Female athlete	15 per cent lower than males

Source: Burke 2007

Fortunately, the high food intake of most athletes ensures a generous protein intake, usually well above requirements. As food intake is increased with the additional energy needs of training, the greater protein needs are easily achieved from a diet selected from a wide variety of foods without the need for expensive protein powders or bars.

While heavily training athletes have greater protein needs than inactive people, the very high protein intakes consumed by some athletes are unnecessary and unlikely to enhance athletic performance. In fact, they may potentially displace other important nutrients from the diet. Conversely, a minority of athletes may be at risk of eating too little protein. Athletes on low-energy diets, and fussy or restrictive eaters, risk eating inadequate amounts of protein, leaving little for muscle repair and growth. Not eating enough protein can compromise muscle size, slow recovery and have serious health problems, such as compromised immune function, if continued for an extended time.

Some individuals choose to follow a vegetarian meal plan, avoiding all animal flesh including red meat, seafood and poultry, but usually including eggs and dairy products. Such eating patterns can easily meet the requirements for protein and other nutrients as long as foods of similar nutritional value are used daily to replace the animal flesh, such as lentils, dried beans and peas. Ready-to-use products are also available, such as tofu, tempeh, textured vegetable (or soy) protein, and ready-made nut, soy or wheat-derived alternatives, eggs and dairy products. Vegetarian athletes should consult a sports dietitian to ensure they are selecting appropriate

foods throughout the day to achieve protein and other essential nutrient needs (for example, iron and zinc).

### **Tips for pumping up the protein**

- . Including a small serve of protein-rich food at meals and snacks (including pre and post-training opportunities) is preferable compared to achieving daily protein needs from just one or two meals. For example:
  - milk on cereal at breakfast
  - a tub of yoghurt with fruit salad as a snack or easy dessert option
  - lean cold meat or cheese on a sandwich
  - lean meat, fish, chicken or vegetarian alternative with an evening meal.
- . Athletes should be guided to choose meal combinations that match protein requirements with other nutrient needs. For example:
  - three or more serves of low-fat dairy foods daily for protein and calcium
  - one or two serves of lean meat, fish, chicken or vegetarian alternatives daily for protein, iron and zinc.
- . Some athletes avoid important protein-rich foods such as meat and dairy foods in the belief that they are fattening. Low-fat varieties of these are readily available and remain excellent sources of protein and other essential nutrients.

### **Fat**

Dietary fat is one of the most commonly discussed yet poorly understood nutrients. With approximately twice the energy of carbohydrate and protein per gram, fat is a very concentrated source of energy. It provides essential fatty acids and fat-soluble vitamins essential for maintaining health and can be an important source of energy. Fat also enhances the flavour and texture of many foods and simplifies the cooking process. In fact, fat is an essential component of a well-chosen diet — it is just a case of getting both the quality and quantity right.

Like most members of the public, many athletes eat too much fat. A high fat intake carries with it the potential to promote body-fat gains and lifestyle-related diseases such as cardiovascular disease. This is especially so for a diet rich in saturated fat, the fat primarily found in animal foods. Of more immediate concern to an athlete is that a diet high in fat can limit carbohydrate



intake. Moderating fat intake will help ensure requirements for fat and associated fat-soluble vitamins can be met without compromising carbohydrate intake.

### **Tips for keeping a low-fat profile**

- . Choose low-fat methods of cooking such as grilling, dry or light frying, baking on a rack, microwaving, steaming or poaching. All these techniques require little or no added fat/oil.
- . Use non-stick pans and make use of oil sprays, providing just the right amount of oil for cooking — a very fine film to stop the food from sticking.
- . When oil is required during cooking, choose predominantly unsaturated vegetable oils such as sunflower, canola, corn, soya, olive and flaxseed, rather than artery-clogging animal fats, palm or coconut oil, or hydrogenated vegetable oils.
- . Choose lean cuts of meat and chicken. Trim meat of all fat and remove the skin from chicken prior to cooking. When purchasing meat, look for the cuts without marbling (a fatty/streaky appearance). Limit intake of sausages, fatty mince, processed meats and 'luncheon' meats. Try to include fish in your diet.
- . Be aware of the fat added to many foods — butter, margarine or mayonnaise on bread, oil-based dressings on salad, oil in tinned fish and meat, or cream (coconut or dairy) in sauces. Use these sparingly or try low-fat alternatives (for example, oil-free dressings, low-fat mayonnaise, evaporated skim milk with coconut essence, tinned fish in water or brine).
- . Use low-fat varieties of foods now readily available (for example, dairy products).
- . Do not be misled by labelling claims such as 'cholesterol-free', 'reduced fat' or 'light'. Learn how to read food labels, avoiding products high in saturated fat.
- . When dining out, choose lower-fat options. This will be especially important if a busy lifestyle results in an increased reliance on takeaway meals. Look for options that are based on noodles, rice or pasta, with a healthy serve of vegetables and some lean meat, fish or chicken. Avoid deep-fried choices, creamy or satay sauces, and options with lots of added oil. Alternatively, double up on ingredients when meals are prepared at home, ensuring leftovers are available for another night of the week.
- . High-fat snacks such as potato or corn crisps, chocolate, biscuits and cakes should only be enjoyed in small quantities and not form the base of mid-meal snacks. A better option

is using high-carbohydrate, low-fat snacks such as sandwiches, fruit bread, fruit, cereal bars, scones, low-fat muffins and low-fat fruit yoghurt.

## Hydration

Even before sweat losses from exercise are considered, the average person requires about two litres of fluid per day. Sweating is the body's primary method of dissipating excess heat and is influenced by an array of factors, including exercise intensity and environmental conditions.

Basically, the hotter it is and the harder an individual works, the more they sweat. Rates of one to two litres per hour are not uncommon among athletes training hard during summer. Failure to match fluid intake to sweat rates results in dehydration, which affects the body in many ways, including impairment to:

- . endurance exercise performance
- . thermoregulation, or the ability to regulate body temperature, increasing the risk of heat stress
- . mental function and skill coordination, with perception of effort increasing
- . gastrointestinal function, increasing the risk of nausea/vomiting and slowing the rate of fluid absorption, so as dehydration sets in, it becomes increasingly difficult to reverse the fluid deficit.

Even mild dehydration (2 per cent body weight reduction or 1.2 litres for a 60-kilogram athlete) can compromise exercise performance in warm environments. The impact on performance is proportional to the degree of dehydration — the more dehydrated an athlete becomes, the more their performance suffers. Furthermore, as the level of dehydration increases, so too does the risk of developing heat exhaustion and heat stroke. In short, each athlete should attempt to minimise dehydration by matching fluid intake with sweat losses as best they can. Replacing 80 per cent of losses is achievable for most athletes, or limiting weight loss during a session to less than 1 per cent (that is, 0.6 kilogram for a 60-kilogram athlete). Unfortunately, the voluntary fluid intake of many athletes replaces less than two-thirds of sweat losses. This is because most people rely on thirst, a very poor indicator of fluid requirements, to gauge their fluid needs.

### Tips for remaining well hydrated

- . Start each session well hydrated by making sure fluid losses from the previous session have been replaced. Drinking in and around training and meals is a great start, but there

needs to be a conscious effort to drink throughout the day, especially in summer. Athletes should keep a drink bottle at their side, all day every day, filled with chilled tasty fluids. The type of fluid may be determined by individual energy needs; that is, water for those with lower-energy needs, while those with higher needs may benefit from nutritious drinks such as fresh fruit juice, low-fat milk shakes/smoothies, etc. This ensures ready access to fluid and is also a great reminder to drink.

- . Experiment with a moderate volume (~250–500 millilitres) of fluid in the 15–30 minutes prior to exercise. This not only helps increase total fluid intake but also primes the stomach to maximise fluid uptake while exercising.
- . Start to drink early and at regular intervals during exercise in an attempt to match fluid intake with sweat rates. Athletes should take advantage of all breaks in training/competition, both formal and informal, to access fluid. With a little training, athletes should be able to tolerate 600–1000 millilitres of fluid per hour or 150–250 millilitres every 15 minutes. Coaches should remember to schedule regular breaks in training to ensure ready access to fluid throughout a session.
- . Water is an excellent choice for shorter-duration or low-intensity sessions, but athletes should consider making use of sports drinks during longer sessions (that is, lasting more than 60–90 minutes). They help to achieve both fluid and carbohydrate needs simultaneously, and most athletes find sports drinks more palatable. This ensures more fluid is consumed, reducing the potential for dehydration. The small amount of sodium in sports drinks further enhances palatability, maintains the drive to drink, and promotes retention of the fluid consumed. Keeping drinks chilled (~15°C) in a cooler is another excellent idea for maximising palatability of fluids. Athletes should be encouraged to drink water between sips of sports drink, further boosting fluid intake while also maintaining good oral hygiene.
- . Monitor athletes' weight before and after exercise. Any weight loss during a session reflects an accumulated fluid deficit (for example, one kilogram of weight loss equates to a fluid deficit of one litre). The fluid deficit should always be kept to less than one kilogram. In recovery, any fluid deficit should be matched with an amount of fluid equivalent to 150 per cent of losses (for example, one kilogram loss during training demands 1.5 litres of fluid in the 2–4 hours of recovery after training).

- . When fluid losses are high or rapid rehydration is required, sodium replacement may also be required. Sports drinks, oral rehydration solutions and/or salty foods (for example, bread, pretzels, cheese, Vegemite, soups, breakfast cereals, dishes with added sauce or salt) can all contribute to sodium replacement, enhancing the retention of ingested fluid by keeping body electrolyte levels in balance.
- . A urine sample taken on waking provides a good index of hydration status over the previous day. While expensive equipment is available to assess urine concentration and thus hydration status, urine colour also offers valuable insight into hydration status. Well-hydrated urine is clear or light-straw coloured and should be copious throughout the day.
- . Prepubescent children are at particular risk of heat illness when exercising in hot environments, making fluid replacement a high priority.

Consuming fluid in excess of requirements may cause gastrointestinal discomfort. In extreme cases, a potentially life threatening condition known as **hyponatremia** (low blood-sodium levels) can occur. It is not common but can occur in prolonged endurance events (lasting two or more hours) when large volumes of low-sodium drinks are consumed and sweat losses are small. Consuming sodium-containing fluids such as sports drinks and matching fluid intake to sweat losses (but not exceeding this level) lowers the risk of hyponatremia.

### **Case study**

Tom coaches a local football team that is about to travel to Townsville for an important multi-day competition. Recognising that even in winter Townsville can be hot and steamy, Tom is keen to assess the fluid needs and drinking practices of his athletes. He starts by doing some fluid-balance studies (weighing the athletes and their drink bottles before and after the session) during training one Saturday in the warmer part of the day. With regular breaks in training and encouragement to drink more, Tom is able to keep weight loss (and thus the imbalance between fluid intake and sweat loss) during the session to less than one kilogram for the majority of the squad. This is repeated when the squad arrives in Townsville, recognising that sweat rates are higher in the warmer environment.

On their first night in Townsville, the squad is instructed to inspect their urine when they first go to the toilet before breakfast each day. The next day the colour tells the story — several athletes report that their urine was dark, a sure sign of dehydration. So while the athletes appear to be good at matching fluid intake to losses during training with the encouragement of Tom, their fluid intake falls off outside of training. It is decided the athletes must carry a drink bottle with them

throughout the day for the duration of the competition. This not only acts as a regular reminder to drink but also ensures the athletes have ready access to suitable fluids throughout the day. A spot check two days later shows that all athletes are producing clear urine, indicating that body fluid levels have been topped up.

## **Competition nutrition strategies**

### **Pre-event fuelling**

Most athletes appreciate that what they eat and drink prior to exercise can have a real impact on performance, but few are aware that fuel and fluid reserves are a result of their eating and drinking behaviours over the previous one to two days. Focusing only on the pre-exercise meal will not fully prepare them for competition. One or two days of tapered training, together with a high-carbohydrate meal plan, will ensure muscle fuel stores are well stocked for most events. For endurance athletes competing in events lasting two hours or more, a more sustained period of fuelling up may be required. The support of a sports dietitian will help identify needs and formulate a suitable meal plan for this time.

The pre-event meal provides a final opportunity to top-up fuel and fluid-level stores while preventing hunger and maximising intestinal comfort. Emphasis should be placed on meal combinations that:

- . are rich in carbohydrate
- . are low in fat
- . are low in fibre
- . include plenty of fluid
- . are based on familiar and enjoyable foods and fluids.

Larger meals are best consumed 3–4 hours before exercise, while smaller snacks can usually be tolerated 1–2 hours before warming up. If the pressure of competition results in stomach 'butterflies', liquid meal supplements or home-made shakes may be the best choice, as they are better tolerated. Examples of suitable pre-race meal and snack ideas are:

- . breakfast cereal/porridge with low-fat milk and fruit
- . bread/toast/muffins/crumpets with jam/honey/syrup, and fruit juice
- . pancakes with maple syrup/jam/lemon and honey, and fruit juice or smoothie

- . baked beans\*/tinned spaghetti on toast
- . fruit smoothie based on low-fat milk/soy milk, fruit and low-fat yoghurt
- . liquid meal supplement
- . sandwiches or rolls with low-fat fillings (for example, banana/jam/honey)
- . rice/noodle/pasta dish with low-fat sauce (for example, napolitana — tomato)
- . cereal bar/sports bar and sports drink
- . fresh fruit and low-fat fruit yoghurt.

\* High fibre choice

### **Nutrition during competition**

Muscle glycogen (the storage form of carbohydrate in the body) stores can be depleted after just 90–120 minutes of high intensity exercise. Anyone who has ‘hit the wall’ will appreciate how bad it feels to deplete carbohydrate stores. The provision of additional carbohydrate while exercising is essential if the performance-sapping effects of fatigue are to be minimised. For endurance events lasting longer than 60–90 minutes, athletes should plan to ingest 30–60 grams of carbohydrate every hour.

While both solid and liquid options are suitable, sports drinks are particularly useful as they simultaneously meet both fluid and carbohydrate needs. Just 500–1000 millilitres of sports drink provides 30–60 grams of carbohydrate.

While solid food may increase the potential for intestinal discomfort, small amounts can help top up carbohydrate intake and stave off feelings of hunger during extended performance efforts. Solid forms of carbohydrate are also more compact and can be easily packed away in sports clothing or taped to equipment. If space is a limitation to the supply of carbohydrate, options such as cereal bars, sports bars and carbohydrate gels are an excellent idea.

### **Recovery strategies**

Training or competing multiple times over a day or week brings with it a number of other challenges. Maximising recovery becomes critical. Refuelling and rehydrating must become priorities, especially when the next session is scheduled within a few hours. Consuming plenty of carbohydrate-rich foods and fluids soon after the completion of exercise will help start restoration of muscle fuel and fluid levels prior to the next session.

Rates of glycogen synthesis remain low until carbohydrate is consumed, so ingesting a snack rich in carbohydrate (perhaps also with some protein) as soon as possible on the completion of exercise should become a priority. Intense exercise can suppress the appetite of some individuals. Making use of compact, low-bulk carbohydrate-rich foods and drinks such as sports drinks, cordial, soft drinks, prepared liquid meal supplements, and cereal or sports bars, can be particularly valuable in this situation. The choice of fluid may vary with individual preferences, but sodium or salt-containing options such as sports drinks may be particularly useful in recovery, enhancing the retention of ingested fluid.

Training and competition venues are unlikely to provide food and fluid choices in line with recovery goals. Appropriate recovery snacks should be packed into a training bag to avoid disappointment. Foods that are usually consumed cold should be kept this way. A cooler with an ice brick can be particularly valuable for both chilled and easily perishable food. Alternatively, more robust recovery options include dried biscuits, powdered liquid meal supplements, rice cakes, tinned fruit, cereal bars, tins of creamed rice and bakery options such as fruit buns and scones.

### **Tips to help maximise recovery**

- . Maintain a high-carbohydrate intake throughout the day.
- . Ingest carbohydrate-rich food and/or fluids as soon as possible after the completion of exercise. Aim to ingest one gram of carbohydrate per kilogram of body weight in the first 30 minutes following the completion of exercise, and repeat this every 1–2 hours until appetite returns and normal meal patterns resume.
- . If appetite is suppressed immediately after exercise, make use of compact, low-bulk carbohydrate-rich foods/fluids such as sports drinks, cordial, soft drink, prepared liquid meal supplements, plus cereal or sports bars.
- . Do not rely on thirst. Calculate fluid deficits and match this with an amount of fluid equivalent to 150 per cent of losses.
- . Making use of sodium-containing foods and/or drinks if dehydrated. While sports drinks contain small amounts of sodium, the salt does not have to come from the fluid. It may be derived from ingested food.
- . Examples of recovery snacks with adequate carbohydrate, sodium and fluid include:
  - fruit, yoghurt and sports drinks

- sandwiches with lean meat/low-fat cheese, plus soft drink or water
- noodle/rice/pasta dish with vegetables, meat and sauce, plus cordial or juice.

Each of these options also contains a small amount of protein to further promote recovery and contribute to daily requirements.

If recovery times are short (less than 1–2 hours) during competitions involving multiple games or a series of heats and finals in the same day, small regular snacks may be better tolerated than one or two meals over the day. Suitable recovery choices when there is little time between events include:

- . liquid meal supplements, milk shakes or fruit smoothies
- . sports bars and cereal bars
- . flavoured yoghurt and milk
- . sports drinks, cordial or juice
- . sports gels or lollies.

Athletes should be encouraged to experiment with their competition eating strategies in training to identify combinations and volumes of food and fluids they feel most comfortable with.

## **Weight loss and weight gain**

Most athletes are required to modify body weight at some stage of their career. For some it may be an attempt to lose weight following injury or an off-season break. Others may need to gain weight and increase size, strength and power. Despite what is written about both weight loss and gain, the basic principles are simple. Weight loss/gain is a result of the balance between energy intake from food ingested and energy expended through daily activities. When intake is less than expenditure, body weight decreases. Conversely, if energy intake exceeds expenditure, body weight will increase.

### **Losing weight/body fat**

The focus of any weight-loss plan should be an emphasis on body-fat reduction. This requires the balance of a suitably designed training program and cleverly designed meal plan that primarily focuses on food quality, rather than reducing the absolute amount of food ingested.



### ***Tips for decreasing energy intake***

- . Keep fat intake in check to help reduce overall energy intake. As a very concentrated source of energy, just a small reduction in fat intake can cause a big drop in total energy intake without affecting the amount of food eaten. However, just eating low fat is rarely enough.
- . Maintain a high intake of fresh fruit and vegetables. These should fill the majority of the plate at a meal. Both are rich sources of vitamins and fibre, but also help to fill out a meal while containing very few calories/kilojoules. Aim for more than 2–3 pieces of fruit and more than 2–3 cups of vegetables per day. For most athletes, that is two meals a day containing moderate amounts of vegetables. Ways to achieve this are to:
  - bulk sandwiches out with generous servings of salad
  - increase the proportion of vegetables in recipes
  - add vegetables to the plate first before serving the meats and carbohydrate choices
  - use fruit instead of heavy desserts to finish off a meal.
- . Adjust carbohydrate intake according to daily needs — higher on heavy training days but lower on lighter or training-free days. High-fibre versions of carbohydrate-rich foods are preferred.
- . Focus on water to meet fluid needs. Energy-containing drinks should be avoided wherever possible (for example, fruit juice, cordial, soft drinks, smoothies and milk, sports drinks). While all can be low fat or fat free, these drinks are easily over-consumed, providing a large number of calories/kilojoules. Sports drinks may be required during prolonged training sessions. Water or low-calorie soft drinks and cordials should be used in small amounts at other times.
- . Include a small amount of protein-rich food at each meal and snack to make it more filling (for example, add some ham or low-fat cheese to a salad sandwich, or have yoghurt and fruit as a between-meal snack).
- . Do not include food as an automatic partner to social activities (for example, lollies at the movies, muffin or pastry with a coffee at the café).
- . Limit alcohol consumption. Alcoholic drinks are high in energy but provide very few essential nutrients.

- . Get organised. Plan the day's food intake so that suitable choices are readily available. Keep some fruit nearby and a low-fat flavoured yoghurt in the fridge.
- . Aim for a weight loss of no greater than 0.5–1.0 kilograms per week. This ensures the greatest likelihood that weight loss is from body fat. Faster rates of loss are likely to come from reductions in both fat and muscle mass. Maintaining muscle mass is critical to performance and also ensures energy expenditure remains high because it is the muscles that are metabolically active, burning up calories throughout the day.

Body composition goals should be aligned with performance outcomes. Athletes should be reminded that it is not necessarily healthy or beneficial to performance to have the lowest level of body fat possible.

### **Gaining weight/muscle mass**

Bulking up can play an important role in the development of many athletes. For most athletes, the intent to bulk up or increase weight is a desire to increase muscle mass and strength. Few athletes intentionally plan to increase body fat. To ensure gains in muscle mass are prioritised, the combination of a well-designed training program plus an energy-rich diet with adequate protein is essential.

Increasing dietary energy intake (that is, calories/kilojoules) is essential if significant gains in muscle mass are to be achieved. For some athletes this can be a real challenge. Frequent and/or prolonged training sessions can limit opportunities for meals and snacks, while intense training can curb appetites. Creative strategies such as greater use of energy-dense snacks and drinks may be required to overcome such obstacles.

### ***Tips for increasing energy intake***

- . Increasing meal/snack frequency. Intestinal comfort is higher when the frequency of meals is increased rather than increasing the size of existing meals and snacks. Eating frequently should become a priority, even during busy days. Including three main meals and two to three (or more) snacks each day should be the aim.
- . Make use of energy-dense drinks (for example, smoothies, milk shakes, powdered liquid meal supplements, fruit juice, cordial and sports drinks) and other nutritious, energy-rich foods (cereal or sports bars, and dried fruit/trail mix). Skim milk powder can be added to homemade milk drinks for an extra protein and energy boost. These drinks can be

particularly useful for athletes unable to tolerate solid food before or after exercise or those with smaller appetites.

- . Low-energy fruit and vegetables, although a great source of nutrients, are best maintained at their current level in the meal plan. This will allow more room for energy-dense, nutrient-rich options. The inclusion of dried fruit is a great way of boosting both energy and nutrient intake.
- . Plan the day's intake of food — what and when. This ensures suitable food and drink is on hand as required. Keeping a ready supply of non-perishable snacks in a training bag can be a great idea (for example, tetra packs of UHT flavoured milk/fruit juice, cereal/breakfast bars, dried fruit, powdered liquid meal supplements and sports drinks).
- . While an increase in energy intake is essential to promote gains in muscle mass, eating for muscle gain should not be considered an excuse to indulge in high-fat, nutrient-poor fast food. This may merely promote gains in body fat that will have to be reduced at a later stage.

### **Other muscle-building tips**

- . While the meal plan should be based on nutritious carbohydrate-rich foods, including a small serve of protein-rich food/fluid at each meal/snack may help to optimise training responses. This may be especially important for pre and post-training snacks.
- . Only after training and diet have been optimised should consideration be given to the use of sports supplements. The professional support of a sports dietitian can help to negotiate the sports supplement market.
- . Set realistic goals and monitor progress regularly. Do not expect miracles — gains of 0.25–0.5 kilogram per week are possible but will depend on an individual's genetic make-up and training history.
- . If gains in muscle mass are a priority, a muscle-building phase should be incorporated into the yearly training program, emphasising consistent allocation of resistance training sessions and limiting additional fitness/conditioning sessions. The specialist skills of a strength coach may be particularly valuable.
- . Be patient. Commitment and perseverance are necessary. Developing optimal levels of strength and muscle mass for sport may take years.

## Monitoring progress

Regular feedback on progress (whether it be weight loss or gain) not only allows adjustments to dietary and/or training interventions, but also offers a valuable source of motivation for the athlete. Sports dietitians can be of assistance in this area. They have specialist training in monitoring body composition via the measurement of body weight and 'skinfolds'.

### Case study

Jeremy is an aspiring discus thrower with cerebral palsy who is hoping to make it to the Paralympics with the support of his coach, Phil. While his technique has improved markedly under the support of Phil, Jeremy's results have started to plateau. With a greater focus on technical issues over the past 6–12 months, Jeremy has only been doing resistance training once or twice a week. With a new program in hand (emphasising regular resistance training sessions and less other conditioning), Jeremy approaches Phil about buying some protein powders and bars to assist with muscle building.

Recognising the small but real risk of purchasing a supplement contaminated with a banned substance, Phil decides to make an appointment for him and Jeremy to see a sports dietitian. After a closer look at Jeremy's meal plan, the sports dietitian suggests that Jeremy needs to boost his overall energy intake rather than just his protein intake. A meal plan is developed that includes three main meals and three snacks, including pre and post-training snacks.

The combination of an adjustment in Jeremy's training program, combined with a commitment to an energy-rich nutritious meal plan, ensures Jeremy is able to increase his body weight by five kilograms over the next four months. His strength is up in the gym and he is throwing personal bests in the field. Jeremy's Paralympic aspirations are becoming a reality.

## Summary

It is valuable for coaches to be able to provide guidance to the athletes they coach regarding appropriate nutritional strategies for training and competition. Eating and hydrating well can positively impact on an athlete's sporting performance. Coaches can assist athletes to understand about good food choices to assist their performance. Hydration is another area where coaches can assist and advise the athletes. Adequate hydration is essential for sporting performance, especially in longer events. Even mild dehydration can affect sports performance, so this is an area for coaches to closely monitor. With a well-balanced diet that takes into account individual food preferences, an athlete's sporting performance can be maximised.

## References and further reading

Australian Department of Community Services and Health 1995, Australian Nutrient Database (NUTTAB).

Australian Institute of Sport 2004, *Survival Around the World*, Murdoch Magazines Pty Ltd. Sydney.

Australian Institute of Sport 2001, *Survival from the Fittest*, Murdoch Magazines Pty Ltd. Sydney.

Australian Institute of Sport 1999, *Survival for the Fittest*, Murdoch Magazines Pty Ltd. Sydney.

AIS Department of Sports Nutrition website ([www.ais.org.au/nutrition](http://www.ais.org.au/nutrition)).

Burke, L 2007, *Practical Sports Nutrition*, Human Kinetics, Champaign, Illinois.

Burke, L 1995, *The Complete Guide to Food for Sports Performance*, Allen and Unwin, Sydney.

Cardwell, G 1997, *Gold Medal Nutrition*, 4th edn, Human Kinetics, Champaign, Illinois.

Hawley, J and Burke, L 1998, *Peak Performance: training and nutrition strategies for sport*, Allen and Unwin, Sydney.

Sports Dietitians Australia website ([www.sportsdietitians.com.au](http://www.sportsdietitians.com.au)).