athletes' medical information

nutrition for athletes

A practical guide to eating for health and performance.

Prepared by the Nutrition Working Group of the Medical Commission of the International Olympic Committee.

Based on an International Consensus Conference held at the IOC in Lausanne in June 2003.

Message from Powerade

The Coca-Cola Company, via the Powerade brand, has formed a very successful partnership with the IOC Nutrition Working Group and the IOC Athletes' Commission. This partnership has created a nutrition brochure which we hope will provide you with practical information for this prestigious sporting event.

We are dedicated to supporting athletes who continue to push the boundaries of personal achievement. Powerade was developed to help athletes perform at their best for longer, thanks to its formulation, which can help delay the onset of fatigue during exercise and prevent dehydration.

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

Good luck in your chosen sport.

Dominique Reiniche
President and Chief Operating Officer
Coca-Cola European Union Group

Foreword by Dr Patrick Schamasch

The IOC and its Medical Commission are pleased to provide athletes with this brochure, developed under the leadership of the IOC 'Nutrition' working group, in close collaboration with the IOC Athletes' Commission.

Its simplicity and reader-friendly layout make this work a reference for all those who, like the IOC Medical Commission, believe that nutrition is one of the decisive elements in high-level athletes' preparations.

Powerade is the partner of the IOC's Medical Commission for this publication and helps us to spread the information in a worldwide campaign to athletes at all levels.

For all those who, without aspiring to take part in the Olympic Games, place sport and physical activity as a top priority, this brochure will ensure better management of their efforts and preparations.

IOC Medical Director

Key messages

Whenever highly talented, motivated and well trained athletes gather for competition, the margin between victory and defeat is small. Attention to detail can make that vital difference.

Diet affects performance, and the foods that we choose in training and competition will affect how well we train and compete. Athletes need to be aware of their nutritional goals and of how they can select an eating strategy to meet those goals.

Diet may have its biggest impact on training, and a good diet will help support consistent intensive training without the athlete succumbing to illness or injury. Good food choices can also promote adaptations to the training stimulus.

Athletes are all 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.

Getting the right amount of energy to stay healthy and to perform well is key. Too much and body fat increases: too little and performance falls and illness results.

Carbohydrate is a key nutrient for energy supply. Athletes must be aware of foods that can help meet their carbohydrate needs and make these a focus of their diet.

Protein foods are important for building and repairing muscles, but a varied diet containing everyday foods will generally supply more than enough protein. Well-chosen vegetarian diets can also meet protein needs.

A varied and wholesome nutrient-rich diet that meets energy needs and is based largely on vegetables, fruits, beans, legumes, grains, animal meats, oils and carbohydrate should ensure an adequate intake of vitamins and minerals.

Maintaining hydration is important for performance. Fluid intake before, during (where appropriate) and after exercise is especially important in hot climates. Salt replacement is important when sweat losses are high.

Athletes are cautioned against the indiscriminate use of dietary supplements.

This booklet contains information that will help athletes to make informed choices to meet their nutritional needs in different situations. It is no substitute for individual advice from a qualified professional, but tries to give practical information that will be of use to the serious athlete.

Introduction: the benefits of eating well

A well-chosen diet offers many benefits to the elite athlete:

- Optimal gains from the training program
- Enhanced recovery 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 to face competition
- Consistency in achieving high level competition 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 inadequate cooking skills
- Poor or outdated knowledge of sports nutrition
- Inadequate finances
- Busy lifestyle leading inadequate time to obtain or consume appropriate foods
- Poor availability of good food choices
- Frequent travel
- Indiscriminate use of large amounts of supplements and sports foods

The information in this booklet is designed to provide coaches and athletes 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 well can allow athletes at all levels of performance to achieve the special goals of their training and competition programs. It makes no sense to train hard and ignore the benefits that follow from good food choices.

'Nutrition for Athletes' is based on the conclusions of the IOC Consensus Conference on Nutrition for Sport, held in Lausanne in June 2003. We gratefully acknowledge the contribution of the conference participants as the expert scientific sources for this booklet.

This booklet was prepared for the **IOC Medical Commission Working Group on Sports Nutrition** by

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We thank Frankie Fredericks and Dr Patrick Schamasch for their insight and comments in the preparation of this booklet.

Energy needs and weight control

An athlete's daily energy intake provides for immediate energy needs (body functions, activity and growth) 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)

Many athletes try to manipulate these factors towards the characteristics that offer advantages to their sport. In most cases, the goals are to change body weight, reduce body fat, increase muscle mass and optimize important fuel stores. Problems can occur when

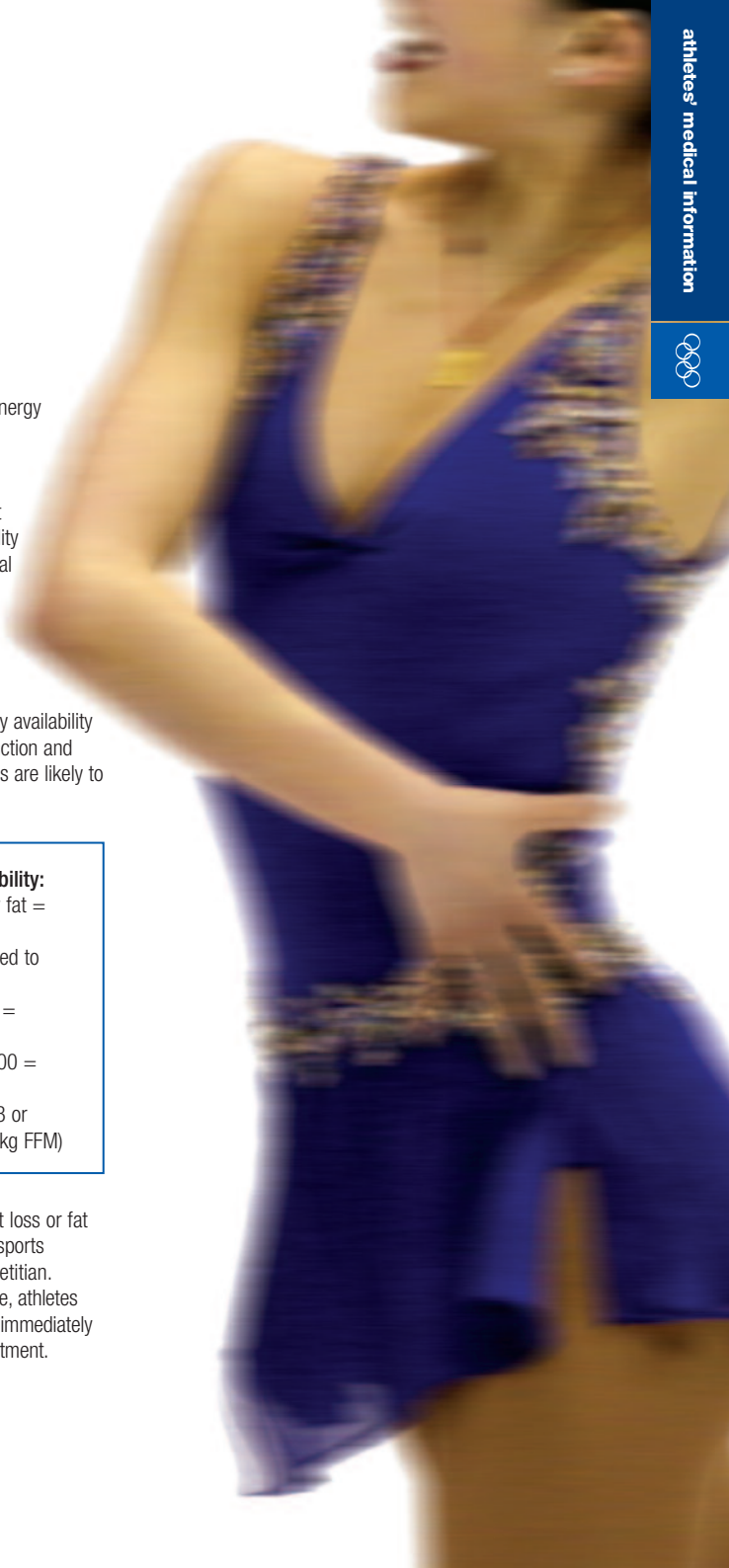
- the athlete is unable to identify goals that are both suitable for their sport, and for their individual make-up
- the athlete is unable to monitor the separate components of their goals (for example, to distinguish changes in body fat from changes in total body weight, or to see whether total energy intake provides for optimal store of body fuels)
- the athlete restricts energy intake to the level that interferes with the body's metabolic and hormonal function

Strategies for managing energy intake and energy balance:

- The athlete should individually manage their energy stores of body fat, carbohydrate (muscle fuel) and protein (muscle mass) by managing intake and expenditure of these nutrients separately. These issues will be discussed in separate parts of this booklet.
- The athlete should eat to a plan that achieves their specific goals rather than relying on appetite to guide energy intake. Advice from a sports nutrition expert is often required to develop this plan.
- The athlete should have a number of separate bio-markers to monitor their progress in achieving each of their energy-related goals.
  - Body weight is not a reliable or accurate indicator of energy balance. Monitoring body weight is often a stressful activity for athletes, especially when the information is misinterpreted or the outcome is manipulated
  - Serial monitoring of skinfold fat thicknesses, especially when undertaken by a trained kinanthropometrist, can provide useful information about changes in body fat stores
  - Urinary ketones can provide a marker of inadequate carbohydrate intake
  - Measurements of changes in muscle strength and endurance provide a useful biomarker of muscle development

Special concerns about restricting energy intake

Although many athletes reduce their energy intake to assist with the loss of body weight and body fat, it is harmful to restrict energy intake below levels that interfere with healthy body function.



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

There is good evidence from recent research that when energy availability drops below a daily intake of 30 kcal (135 kJ) per kg fat-free mass (FFM), there are substantial impairments of metabolic and hormonal function, which 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:

- 60 kg female with 20% body fat = 48kg FFM
- Daily energy intake is restricted to 1800 kcal (7560 kJ)
- Cost of daily exercise (1 h/d) = 500 kcal (2100 kJ)
- Energy availability = 1800-500 = 1300 kcal (5460 kJ)
- Energy availability = 1300/48 or 27 kcal/kg FFM (113 kJ per kg FFM)

Athletes requiring advice for weight loss or fat loss should seek guidance from a sports nutrition expert such as a sports dietitian. To avoid irreversible skeletal damage, athletes with menstrual disorders should be immediately referred to a medical expert for treatment.

Fuel needs for training and recovery

Carbohydrate provides an important but relatively short-lived supply of fuel for exercise that must be refilled each day from carbohydrate foods in the diet. The athlete's everyday eating plan needs to provide enough carbohydrate to fuel their training program and to optimise the recovery of muscle glycogen stores between workouts. General targets can be provided for carbohydrate needs, based on the athlete's size and the demands of their training program (see Table below). However, actual needs are specific to the individual athlete and need to be fine-tuned with consideration of the athlete's total energy needs, specific training needs and feedback from their training performance.

Targets for carbohydrate intake

- Immediate recovery after exercise (0-4 hours): about 1 g per kg BW of the athlete's body weight per hour, perhaps consumed at frequent intervals
- Daily recovery from a moderate duration/low intensity training program: 5-7 g per kg BW per day
- Recovery from moderate-heavy endurance training: 7-12 g per kg BW per day
- Daily recovery from extreme exercise program (more than 4-6 h+ per day): 10-12 g or more per kg BW per day

Strategies for choosing carbohydrate foods and for optimising glycogen recovery

- When the period between workouts is less than 8 hours, carbohydrate intake should start as soon as practical after the first session to maximise the effective recovery time. There may be some advantages in meeting carbohydrate targets as a series of snacks during the early recovery phase.
- During longer recovery periods (24 hours), the pattern and timing of carbohydrate-rich meals and snacks does not appear to be critical, and can be organised according to what is practical and comfortable for each athlete. There is no difference in glycogen synthesis when carbohydrate is consumed in liquid form or as solid foods.
- It is valuable to choose nutrient-rich carbohydrates and to add other foods to recovery meals and snacks to provide a good 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 targets or when frequent snacking is not possible.
- Carbohydrate-rich foods with a moderate to high glycaemic index (GI) provide a readily available source of carbohydrate for glycogen synthesis, and should be the major fuel choices in recovery meals.
- Adequate energy intake is also important for optimal glycogen recovery; the restrained eating practices of some athletes, particularly females, make it difficult to meet carbohydrate intake targets and to optimise glycogen storage from this intake.

Special comments:

- Guidelines for carbohydrate should not be

provided in terms of percentage contributions to total dietary energy intake. Such recommendations are neither user-friendly nor strongly related to the muscle's absolute needs for fuel.

- The athlete should not consume excessive amounts of alcohol during the recovery period since it is likely to interfere with their ability or interest to follow guidelines for post-exercise eating. The athlete should follow sensible drinking practices at all times, but particularly in the period after exercise.

Examples of carbohydrate foods with moderate-high Glycaemic Index:

- Most breakfast cereals
- Most forms of rice
- White and brown breads
- Sports drinks and soft drinks
- Sugar, jam and honey
- Potatoes
- Tropical fruits and juices

Examples of nutrient-rich carbohydrate foods and meal combinations

- Breakfast cereal with milk
- Flavoured yoghurt
- Fruit smoothie or liquid meal supplement
- Sandwich with meat and salad filling
- Stir-fry with rice and noodles

Protein needs for training and bulking up

Protein has been considered a key nutrient for sporting success by athletes of all eras. 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 form 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 sports scientists have suggested that endurance and resistance-training exercise may increase daily protein needs up to a maximum of 1.2-1.6 g 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 and universal. Part of the confusion is caused by problems involved in scientific techniques used to measure protein requirements.

The debate over protein needs of athletes is largely unnecessary. Dietary surveys show that most athletes already consume diets providing protein intakes above 1.2-1.6 g/kg/d, even without the use of protein supplements. Therefore, most athletes do not need to be encouraged or educated to increase their protein intakes. Rather, athletes who consume adequate energy intake from a variety of nutrient-rich foods should be confident of meeting their protein needs, including any increases that could arise from high-level training.

- Athletes 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 also important in promoting protein balance or increasing protein retention.

Although some resistance-trained athletes and body builders consume protein intake in excess of 2-3 g/kg BM, there is no evidence that such dietary patterns enhance the response to training or increase the gains in muscle mass and strength. While such diets are not necessarily harmful, 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 focussed on the acute response to workouts of both endurance and resistance training. 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 hypertrophy, repair and adaptation following the exercise stimulus. Such studies have found that the intake of protein, combined with carbohydrate, enhances protein recovery. There is some evidence that the response is enhanced when these nutrients are provided soon after exercise, or in the case

of a resistance workout, perhaps immediately before training. Further work is required to fine tune guidelines for the optimal amount, type and timing of intake of these nutrients, and to confirm that these eating strategies lead to an enhancement of the goals of training.

In the meantime, it appears sensible to focus on the total balance of the diet and the timing of protein-carbohydrate meals and snacks in relation to training, rather than high protein intakes per se.

- Special sports foods such as sports bars and liquid meal supplements can provide a compact and convenient way to consume carbohydrate and protein when everyday foods are unavailable or are too bulky and impractical to consume. However, the addition cost of these products must be taken into account. There is little justification for using very expensive protein-only powders or amino acid supplements.

Protein rich foods –
10 g protein is provided by

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

Vitamins, minerals and anti-oxid for training and staying well

Strenuous bouts of prolonged exercise and heavy training, particularly aerobic exercise, stress the body. Adequate intakes of energy, protein, iron, copper, manganese, magnesium, selenium, sodium zinc, and vitamins A, C, E, B6 and B12 are particularly important to health and performance. These nutrients, as well as others, are best obtained from a varied and wholesome nutrient-rich diet based largely on vegetables, fruits, beans, legumes, grains, animal meats, oils and carbohydrate energy. Dietary surveys show that most athletes are well 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, especially 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 sports nutrition expert such as a sports dietitian. 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. This should be undertaken with the advice of a qualified sports nutrition expert. 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

It is not known whether hard training increases the need for dietary antioxidants, as the body naturally develops an effective defence with a balanced diet. Supplementation with antioxidants cannot be recommended because there is little evidence of benefit, while it is known that over-supplementation can diminish the body's natural defence system.

Ideas for promoting dietary variety and nutrient-rich eating

- Be open to trying new foods and new recipes
- Make the most of 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

ants

Special concerns

Iron. Some athletes may develop iron deficiency and this will impair performance. Unexplained fatigue, especially in vegetarian athletes should be explored. 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 causes of an athlete's fatigue or other issues of poor eating. See the section on "Special needs for winter sports" for iron-rich eating strategies.

Calcium. Calcium is important for healthy bones, especially in adolescents and in female athletes, so it is important to ensure adequate calcium intake. The best sources are dairy produce, including low fat varieties. Each athlete should aim to include at least 3 servings of these foods in their daily eating plans (e.g. glass of milk, slice of cheese, carton of yoghurt). Additional daily servings are required during growth spurts in childhood and adolescence, and for pregnancy and lactation. Fortified soy foods may provide a useful substitute where athletes cannot consume dairy foods.

Preparation for competition

Many athletes appreciate the need to rest and eat well during the 2-3 days prior to competition or a particularly intense day of quality training, but questions arise regarding how much to eat, what type of food and when is the best time. This includes what to eat during the six-hour period immediately before competition or intense training.

Carbohydrate is the key energy-providing nutrient that must be optimised during the days leading up to and including the day of competition. Attention should also be given to optimising water and salt levels in the body. However, during the 2-4 days prior to a competition, an athlete's need for protein and fat, as well as most other nutrients, typically does not increase above the levels that are recommended for normal moderate level training.

'Carbo-loading'

Athletes who compete intensely for more than about 90 minutes benefit from 'carbohydrate-loading' for a few days. This loading of muscle glycogen to super-compensated levels can be achieved within 2-3 days by eating a large amount of carbohydrate (about 8-10 g CHO per kg of body weight per day; see below) at the same time that training intensity is reduced to no more than easy levels of short duration. It is assumed that a moderate to hard bout of fatiguing exercise is performed in normal training sometime earlier in the week prior to competition.

One Day Example of foods providing 630 g of carbohydrate for a carbohydrate loading diet* (for a person weighing 70 kg with an intake of 9 g CHO /kg).

- Early AM - 150 g = 2 cups cereal with milk + 250 ml fruit juice + 1 banana + 2 thick slices toast + thick spread of jam
- Late AM - 50 g = 500 ml soft drink
- Mid-day - 150 g = 1 large bread roll + 1 medium muffin + fruit smoothie
- Snack- 50 g = 200 g flavoured yoghurt + 250 ml fruit juice
- Dinner - 200 g = 3 cups cooked pasta + 2 cups fruit salad + 2 scoops ice cream + 500 ml sports drink
- Snack - 30 gm = 50 g chocolate

(*note that other foods may be eaten at the meal)

Carbohydrate in the 6-h period before competition

Athletes sometimes find a favourite pre-competition meal that not only provides extra energy during the event, but also feels 'right' in terms of curbing hunger, quieting their stomach and being convenient as well as practical. In sports that do not cause fatigue or carbohydrate depletion (e.g., gymnastics, ski-jumping, etc), the pre-event meal need not be predominantly carbohydrate. However, in intense competitions lasting longer than about 60 minutes, athletes are advised to either:

- Eat 1-4 g/ kg body weight of carbohydrate during the 6-h period before exercise, or
- Take in no carbohydrate, if preferred, but only when a carbohydrate loading diet has been followed during the prior 2-3 days and the competition is not late in the day.

The main 'mistake' athletes might make is to eat too little carbohydrate (less than 1 g CHO /kg body weight) during the 1-6 h period before exercise and then not take in carbohydrate during exercise. This small carbohydrate meal 'primes' the body to rely more heavily on blood glucose, but it does not provide enough carbohydrate to sustain the athlete.

Five different examples of foods that each provide 140 g CHO in a pre-competition meal* (2 g/kg for a 70 kg person) are:

- 2.5 cups breakfast cereal + milk + large banana
- Large bread roll or 3 thick slices bread + thick spread honey
- 2 cups boiled rice + 2 slices bread
- 4 stack pancakes + ½ cup syrup
- 60 g sports bar + 500 ml liquid meal supplement or fruit smoothie

(*note that other foods may be eaten at the meal)

Fluid intake prior to competition

Athletes should drink sufficient fluid with meals on the day before competition to ensure hydration on the morning of competition. The athlete should not refrain from drinking water or carbohydrate-containing fluids during the hours leading up to warm-up before competition and it is recommended that approximately 400-700 ml be ingested during the 60-90 minute period before the start of the event. This will allow sufficient time for urination of excess fluid, and thus rest-room facilities should be identified. During competitions lasting longer than 1 hour and which cause heavy sweating without sufficient opportunity for fluid intake, athletes often benefit by drinking 300-600 ml of fluid during the 15 minute period immediately before the start of the event.

Fluid, carbohydrate and salt needs during and after exercise

Athletes generally appreciate the need to drink fluids during exercise and the importance of sometimes adding some carbohydrate and salts. The next step in applying this theory for optimal performance and well-being is to learn the practical aspects of: a) how much, b) what type of foods, drinks, products, c) when during exercise, and d) what modifications should be made in hot or cold environments. 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 during exercise. Athletes, coaches and trainers should 'fine tune' these recommendation to identify their own winning formula.

How Much to Drink?

Limit dehydration during workouts and competitions by trying to drink at a rate that is close to sweat rate and thus minimizes loss of body weight.

It may not be necessary to drink enough to prevent loss of body weight, but the amount of dehydration should be limited to no more than a 2% loss of body weight (ie, 1.0 kg for 50 kg person, 1.5 kg for a 75 kg person, and 2 kg for a 100 kg person).

In warm environments, try to minimize dehydration, as dehydration and exercise intensity interact to cause heat illness.

Don't drink so much that you actually gain weight during exercise. It is not necessary for a runner to drink more than 2-4 litres during an entire 42 km marathon run.

When it is not possible to drink during 'heavy sweating' type exercise lasting longer than 30 min, practice drinking during the 15 minutes before exercise and find how much is initially filling but comfortable once exercise begins (e.g., 300-800 ml).

When do you need more than water?

- In terms of proven performance benefits, no nutrients match water and/or carbohydrate.
- During exercise lasting longer than 1 h and which elicits fatigue, athletes are advised to ingest 20-60 grams per hour of carbohydrate that is rapidly converted to blood glucose. This generally improves performance.
- The use of commercial sports drinks with a carbohydrate content of about 4-8% (4-8 g/100 ml) allows carbohydrate and fluid needs to be met simultaneously in most events. This carbohydrate can come from sugars (i.e., sucrose, syrups containing no more than 50% fructose, glucose), maltodextrins or other rapidly digestible carbohydrates.
- If carbohydrates are ingested immediately before exercise or during rest periods in a long contest (more than 40 minutes) it is sometimes beneficial to continue to ingest 20-60 grams per hour throughout the contest. This maintains the flow of glucose into the blood-stream.
- Sodium should be included in fluids consumed during exercise lasting longer than 1-2 hours or by individuals during any event that stimulates heavy sodium loss (i.e., more than 3-4 grams of sodium).
- Caffeine contained in commonly available

beverages and foods can enhance endurance power during the final hour of prolonged exercise. This benefit can be obtained with relatively small doses of caffeine (about 1.5 mg/kg bodyweight; e.g., 100 ml of brewed coffee or 500-750 ml of a cola beverage) that are commonly consumed by people of various cultures.

How to estimate sweating rate:

1) Measure body weight both before and after at least one hour of exercise under conditions similar to competition or a hard practice.
2) Measure body weight wearing minimal clothing and while bare footed. Towel dry after exercise and obtain body weight as soon as is practical after exercise (e.g. less than 10 min).
3) Sweat loss (Litres) = Body weight before exercise (in kg) - Body weight after exercise
4) 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

Replacement of sweat losses is an essential part of the recovery 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 loss 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 supply the salt that is needed. A little extra salt may usefully be added to meals when sweat losses are high, but salt tablets should be used with caution.

Recovery after exercise is part of the preparation for the next exercise session, and all athletes, including strength and power athletes, will perform below their best if they are not well hydrated when they begin exercise.

Just like shoes, don't try out new plans for fluid and fuel intake during important competition. Do it in practice and find what fits you best.

Supplements and sports foods

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.

Supplement use is widespread among sportsmen and women, but few of these products are supported by a sound research base and some may even be harmful to the athlete. 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. 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 (See section 3).

Protein-carbohydrate supplements may have a role as part of a post-exercise recovery plan, but whole proteins have advantages over individual amino acids (see box above).

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 are either on the banned list 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 has anything worthwhile to offer the athlete.

Increasing energy supply

Supplements in this category include carnitine, 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, none is supported by good independent evidence.

Nutrition and the immune system

There is some evidence that athletes who are training hard may be at increased risk of minor illnesses and infections. In themselves, these are generally trivial, but they can interrupt training or cause an 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 effective. The best evidence supports the use of a high carbohydrate diet, which lowers stress hormone levels, and appropriate rest periods.

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. In most cases these nutrients can be supplied by the diet. Athletes who suffer from 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. There is some evidence that long-term (2-6 months) glucosamine treatment can provide subjective relief in elderly individuals suffering from osteoarthritis, but there little no evidence of benefit for otherwise healthy athletes.

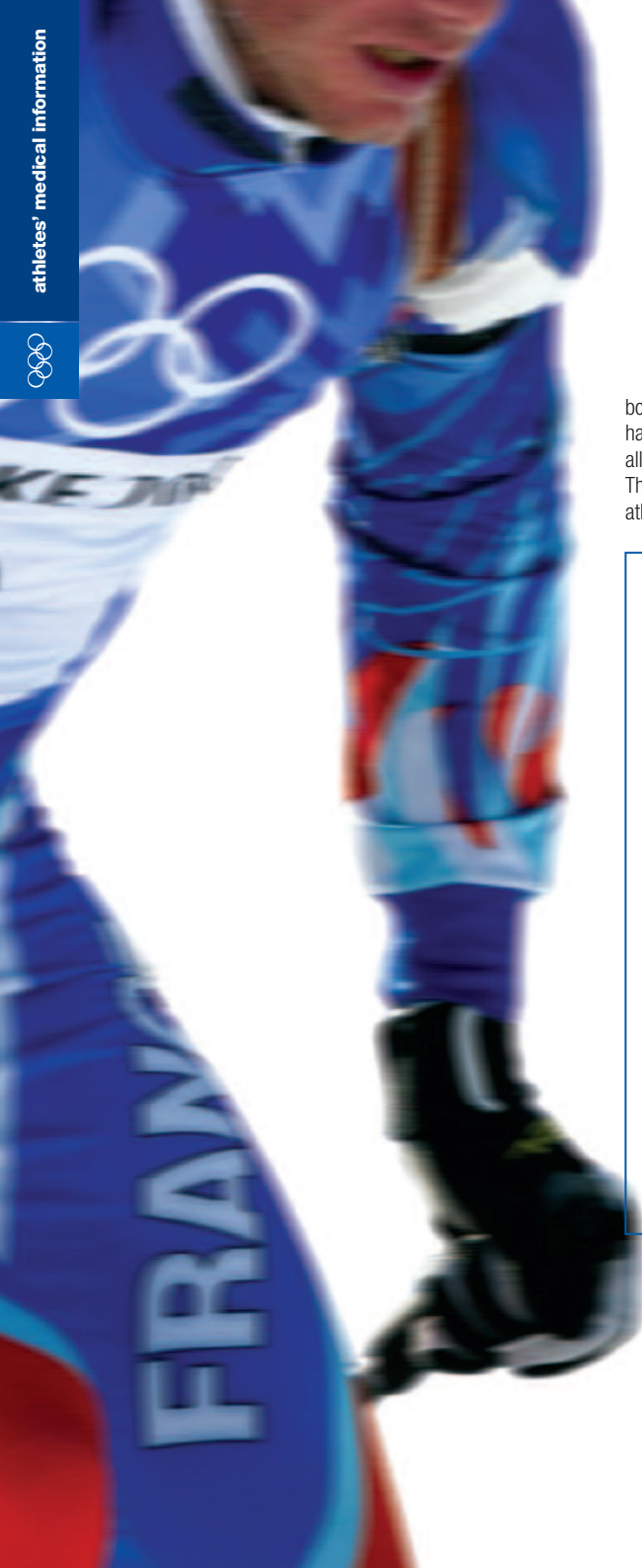
Supplements that might work

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

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 is 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 (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. This is likely to be a problem in multi-day events and in sports involving heats and finals.

Bicarbonate. In very hard exercise, the muscles produce 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 sodium bicarbonate (in a dose of about 0.3 g per kg



body weight) before an event can counter the harmful effects of lactic acid. This can help in all-out events lasting from about 1-8 minutes. There is a risk of gastrointestinal problems, and athletes should experiment in training.

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 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 programs 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 ingredients – especially the expensive ones – that are listed on the label. Contamination of dietary supplements with substances 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 to know that they are present.

At present, there can be 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 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. These include: Tribulis Terrestris; Chrysin; Indole-3-Carbinol; Saw Palmetto; Gamma-oryzanol; Yohimbine; Smilax; Mummio. All of these claims are based on studies in test tubes and none has been shown to work in humans. 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 for endurance sports

Training issues

A demanding endurance training program 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 athletes. 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

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 endurance athlete

To achieve carbohydrate intake targets to meet the fuel demands of training and recovery, meals and snacks should be based around carbohydrate-rich foods.

- Breads and flour-based foods
- Rice, pasta, noodles and other grain foods
- Breakfast cereals
- Fruits
- Starchy vegetables and legumes
- Flavoured dairy foods (e.g. yoghurt)
- Sugary foods and drinks

Nutrient-dense carbohydrate choices, and 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.

Endurance athletes with very high energy needs may find it valuable to spread their daily food intake over a series of meals and snacks. 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 (see section 12). Well-placed snacks may help prevent hunger and energy drain over the day and may 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 events lasting longer than about 90-120 minutes, many athletes carbohydrate load, by tapering their training and increasing carbohydrate intake for 2-3 days prior to the race.

The pre-event 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 the pre-event meal, will vary between athletes and should be fine-tuned with experience to avoid gastrointestinal disturbances during the event.

In long events there may be a need and opportunity to refuel and rehydrate "on the run". Sports drinks provide a good balance of fluid and carbohydrate to meet both goals, and are designed to taste good to encourage intake. Each athlete should develop a fluid intake plan based on knowledge of expected sweat losses and how much of this is practicable to replace. Fluid intake should not exceed sweat losses. In very long events, sports bars, gels and everyday carbohydrate foods provide an additional source of carbohydrate for variety and extra fuel intake. Typically, a fuel intake of ~ 20-60 g per hour is suitable, but should be fine-tuned according to individual needs and experience. 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 (See team sports for ideas).

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
- ~ ¾ sports bar
- 1 large or 2 small bananas
- 1 thick slice of bread and jam/honey
- 35-40 g candy/confectionery

Remember fluid needs too!

Special needs for team sports

Training issues

- Many team sports involve seasonal competition. At the recreational level, the off-season can be lengthy and players often lose fitness and gain body fat as a result of detaining and poor eating practices. This may also occur during the season when players are injured. At the elite level, most team athletes train all year, with just a brief break between seasons.
- Refuelling is an important part of the recovery between matches, and from the team and individual training sessions that occur between games. Traditionally, many team players have focussed on fuelling up only on the day before a match or in the pre-event meal. However, the daily demands of training are best met by a permanent approach to adequate fuel intake.
- Physique is important in the performance of some sporting codes, or positions within a code. Many team athletes have special nutritional needs to support a resistance training program, or a rapid growth spurt. While protein needs are often emphasised, total energy and fuel intake, and the timing of meals/snacks in relation to training are perhaps more important.
- Large fluid losses often go unrecognised in team sports, or are even promoted as a means to lose weight or "toughen up" players. High-intensity work creates large sweat losses even in cold weather, and special needs should be recognised in warm conditions or when heavy clothing and protective gear is worn.

Match issues

- Competition can be played in weekly league games, or as a tournament with games ever day or several days. Recovery needs must be adjusted according to the schedule.
- Depletion of fuel stores can be an issue for team games lasting longer than 60 minutes, especially for players in mobile positions or with a running game style. High carbohydrate strategies – fuelling up for the game and consuming extra carbohydrate during the match – have been shown to enhance performance in team sports. Hydration strategies are also important for optimal performance. Better match nutrition may not only keep players running further and faster in the second half of a match, but may help to maintain skills and judgement when players would otherwise become fatigued. Games are often won and lost in the last minutes of the match, and fatigued players are at increased risk of injury.

Eating strategies for team athletes

Team-sport players may adopt the eating strategies outlined for endurance athletes, and should eat well and stay active all year round. The following strategies may be of additional value:

- Many team sports have a large contingent of young players who are "fresh from home". It is a good team strategy to organise cooking and shopping classes for young players to help them develop the domestic skills and nutrition knowledge that will allow them to reach their full potential as players, Athletes looking after themselves for the first time

can find it hard to juggle the team commitments, as well as work/school. Many recipe books developed for athletes offer quick and nutritious meal ideas suited to the special needs of sport.

- The pre-event meal is a good opportunity for a shared meal, ensuring good last-minute nutritional preparation as well as an opportunity to boost morale and share final tactics. Ideas for pre-event meals are found in the Winter sport section, and are best provided as a buffet, to allow each team member to choose their individual needs and likes.
- Various opportunities exist for players to refuel and rehydrate during team sports – these include quarter or half time breaks, substitutions and time-outs. Some codes even allow trainers to carry drinks to players on the arena during breaks in play. A creative plan should be developed for each team.
- Post-game or post-training recovery is another good opportunity for team nutrition. Alcohol is often a large part of post-game activities in team sports but should be discouraged, unless in moderation and after recovery eating goals are achieved. Post-game snacks and light meals providing nutritious forms of carbohydrate and protein as well as rehydration options will help players to recover effectively while celebrating or commiserating the results of the match.

Ideas for post-exercise recovery snacks

Each choice provides ~ 50 g carbohydrate and a valuable source of protein and other nutrients

- 250-350 ml fruit smoothie or liquid meal
- 60 g (1-2 cups) breakfast cereal + milk + 1 fruit
- 200 g carton of yoghurt + cereal/breakfast bar
- 1 round of meat/cheese and salad sandwiches or roll + 250 ml fruit juice
- 150 g thick crust pizza – lean meat and vegetable toppings and easy on the cheese
- 60 g sports bar + 250 ml sports drink

Special needs for power and sprint sports

Training issues

- The goal of many power and sprint athletes is to enhance muscle mass and strength through specially designed resistance training programs. 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) 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 before or 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 claim 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 protein and carbohydrate soon after the session. It may be even more valuable to consume this "recovery snack" immediately before the workout.
- A few supplements and sports foods provide valuable benefits to the athlete's training and competition program. 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 program, 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 program.

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 more 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. The athlete should use creative ideas and good planning to arrange a supply of portable snacks and drinks that can travel with them over their day.

Food combinations supplying carbohydrate and protein

- Breakfast cereal and milk
- Sandwiches with meat, cheese or egg fillings
- Meat/fish/chicken stir-fries served with rice or noodles
- Fruit smoothies or liquid meal supplements
- Fruit and yoghurt
- Dried fruit and nut mixes

Special needs for winter sports

Training and competition issues

- Winter sports encompass a wide range of events – endurance events such as cross-country skiing, team games such as ice hockey, sprint events such as speed skating, and weight conscious sports such as figure skating. In most cases, the major nutritional needs for these sports are derived from the physiological characteristics of the event and are covered in the previous pages of this booklet.
- Additional nutritional issues for Winter sport athletes include the special needs arising from the environments in which they are often undertaken – extreme cold and high altitude.

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 in high-intensity sports of prolonged or intermittent duration, 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 sports to undertake fluid monitoring sessions (see section 6) 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 program.
- 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 winter sport athlete should take a pro-active role in maintaining fluid and fuel status during prolonged workouts or during periods of intensive training. Since many training venues are held in wilderness areas, some creativity is required to ensure that an adequate supply of foods and fluids are available during exercise and 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 winter sport 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), the athlete should ensure that their diet is rich in anti-oxidant containing fruits in vegetables, and in iron-rich foods.

Ideas for high carbohydrate pre-event meals*

Breakfast menus

- Breakfast cereal and milk, fresh or canned fruit
- Toast and jam/honey
- Pancakes and syrup
- Fruit-flavoured yoghurt
- Baked beans or tinned spaghetti on toast
- Liquid meal supplement or fruit smoothie

Lunch and dinner menus

- Rice dishes – risotto, fried rice, paella
- Pasta and light sauce
- Bread, including rolls and sandwiches
- Fruit and fruit based desserts
- Rice pudding

* A low-fat or low-fibre menu may help to reduce the risk of gastrointestinal problems in susceptible athletes

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)

Special needs for weight conscious sports

Training issues

The key nutritional interest of many athletes is to reduce body weight and body fat. A low level of body weight and body fat often provides a benefit to performance. In other sports involving subjective outcomes (e.g. gymnastics, diving, body building), the athlete who is lean and trim is judged to have a higher aesthetic appeal. Although certain body shapes and physiques are held up as "de rigueur" for many sports, each athlete must be realistic in setting targets for the weight and fat loss programs they undertake.

Challenges occur for the athlete whose training does not involve high energy expenditure work – for example, the athlete who undertakes lengthy training sessions that are primarily based on skill and agility. It is more difficult to create the energy deficit needed to reduce weight and body fat when basal energy needs are low to moderate.

- Restrictive eating and fad diets can lead to dehydration and fuel depletion, marring training performance and increasing the risk of injury and accidents, rather than achieving effective loss of body fat.

Competition issues

In many combat sports (boxing, wrestling, martial arts), some strength sports (weight lifting) and lightweight rowing, competition involves weight divisions that attempt to provide a match between athletes of equal size and performance. In such sports, athletes typically try to lose weight in the days before the competition (and its pre-event weigh in), in order to qualify for a weight division that is lighter than their habitual body weight and gain an advantage over a smaller opponent. Acute strategies to "make weight" expose the athlete to health and performance risks arising from dehydration, fuel depletion, inadequate nutrient intake, and psychological stress.

Strategies for athletes in weight conscious sports

Athletes will benefit from professional advice from an expert such as a sports dietitian to set realistic goals for weight and fat loss attempts, and a suitable long-term eating plan.

The athlete in skill-based sports should seek their coach's input to introduce or increase aerobic workouts that can increase overall energy expenditure without detriment to key training sessions. This may include changes to lifestyle to increase incidental exercise or activity in the day.

Athletes who compete in weight division sports should settle for a weight category that is close to the training weight that can be achieved with a safe and healthy plan. Final "fine tuning" of weight prior to the event should not involve changes of >1-2% body weight, and should be undertaken without resort to extreme techniques of dehydration and fasting.

- Athletes in weight conscious sports may be at higher risk of disordered eating and eating disorders than other athletes or the sedentary population. It is important that athletes who develop warning signs of such problems are refereed at an early stage for expert team-based advice.

Strategies for staying lean and trim

- Assess portion sizes at meals to ensure that over-eating does not occur due to habit or unnecessary hunger
- Use well-chosen snacks between meals to maintain fuel levels for training sessions or to avoid excessive hunger. However, avoid snacking for entertainment or comfort. Snacks can often be organised by saving part of a meal for a later occasions, rather than by eating extra food.
- Use low-fat strategies in choosing foods and while cooking or preparing meals
- Make meals and snacks more "filling" by including plenty of salads and vegetables, by taking the higher-fibre option, and by including low glycaemic forms of carbohydrate.
- A food record will help to identify the difference between an athlete's desired eating plan, and their actual intake. Many people are unaware of the habits that sabotage their eating goals

Examples of incorporating low glycaemic index carbohydrate foods into meals

- Enjoy rolled oats (porridge or low-fat versions of Bircher Muesli) instead of Cornflakes for breakfast
- Replace white and wholemeal breads with wholegrain and multi-grain choices
- Add lentils and legumes to casseroles and pasta sauces
- Enjoy flavoured yoghurt as a snack
- Replace mashed potato with al dente pasta or buckwheat

Special needs for the travelling athlete

Most elite athletes are well-seasoned travellers, seeking competition or specialised training environments far away from home. In many team sports, high-level competition is organised in a national or regional league that requires weekly or biweekly travel to matches. 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

Ideas for portable supplies for the travelling athlete

- 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.

References

Nutrition for the athlete is based on information discussed at the IOC Consensus Conference on Nutrition for Sport, held in Lausanne in June 2003. The papers presented at that meeting were published as a Special Issue of the Journal of Sports Sciences (Volume 22 No.1. January 2004)

1. Energy balance and body composition in sports and exercise **Anne Loucks**
2. Carbohydrates and fat for training and recovery **Louise Burke, Bente Kiens, John Ivy**
3. Pre-exercise carbohydrate and fat ingestion: effects on metabolism and performance **Mark Hargreaves, John A Hawley, Asker E Jeukendrup**
4. Fluid and fuel intake during exercise **Ed Coyle**
5. Fluid and electrolyte needs for preparation and recovery from training and competition **Susan Shirreffs, Samuel Cheuvront, Lawrence Armstrong**
6. Protein and amino acids **Kevin Tipton, Bob Wolfe**
7. Dietary antioxidants and exercise **Scott Powers, Keith C DeRuisseau, John Quindry, Karyn L Hamilton**
8. Dietary supplements **Ron Maughan, Doug King, Trevor Lea**
9. Exercise, nutrition and immune function **Mike Gleeson, Bente Pedersen, David Nieman**
10. Nutritional strategies to influence adaptations to training **Lawrence Spriet, Marty Gibala**

Commentaries
1. Protein and amino acid requirements of athletes **D. Joe Millward**
2. Exertional Hyponatraemia **Lawrence E. Armstrong**

IOC Consensus Statement on Sports Nutrition 2003

The amount, composition and timing of food intake can profoundly affect sports performance. Good nutritional practice will help athletes train hard, recover quickly and adapt more effectively with less risk of illness and injury. Athletes should adopt specific nutritional strategies before and during competition to help maximise their performance. Athletes will benefit from the guidance of a qualified sports nutrition professional who can provide advice on their individual energy and nutrient needs and also help them to develop sport-specific nutritional strategies for training, competition and recovery.

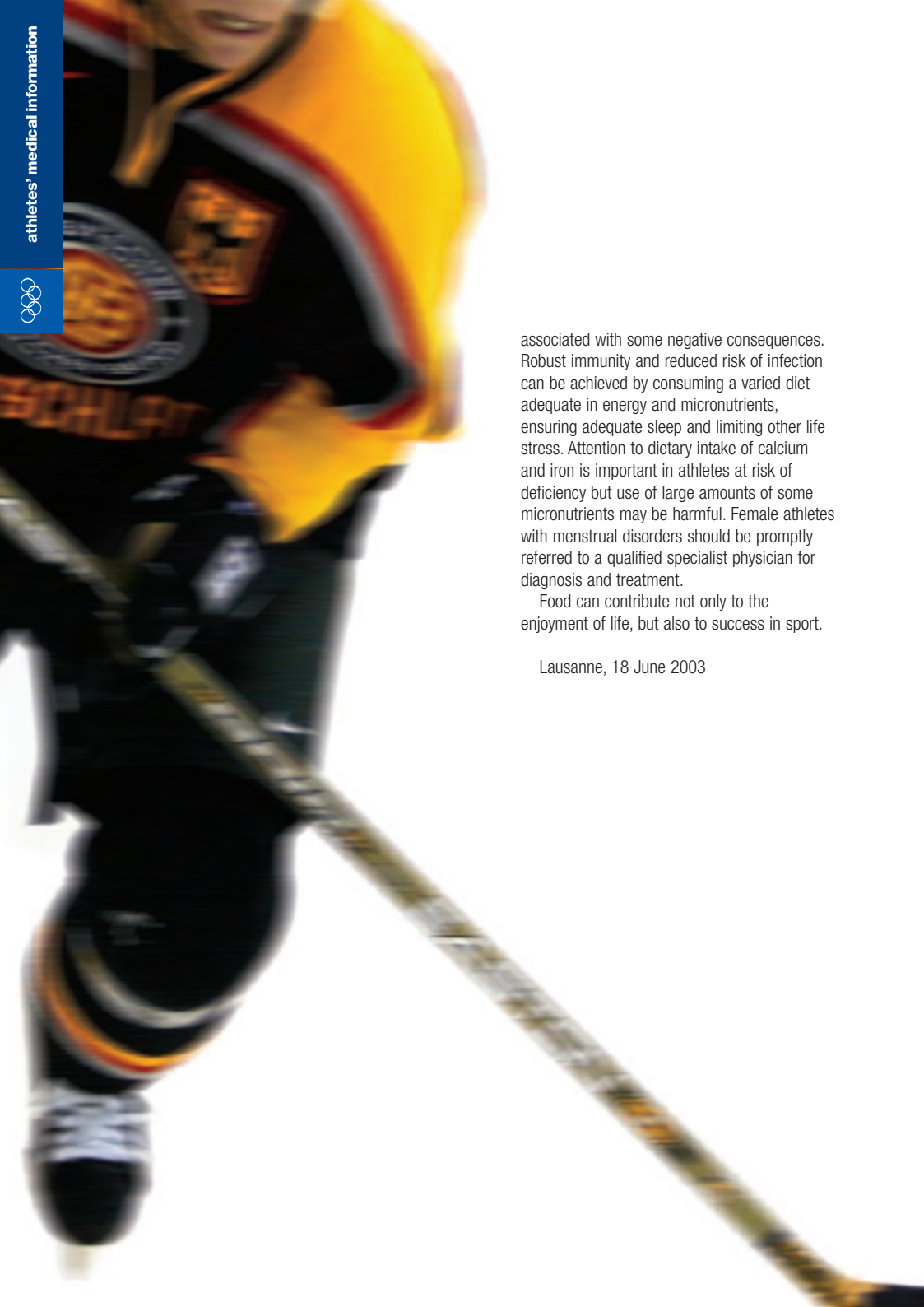
A diet that provides adequate energy from the consumption of a wide range of commonly available foods can meet the carbohydrate, protein, fat, and micronutrient requirements of training and competition. The right diet will help athletes achieve an optimum body size and body composition to achieve greater success in their sport. When athletes restrict their food intake, they risk nutrient deficiency that will impair both their health and their performance. Careful selection of nutrient-dense foods is especially important when energy intake is restricted to reduce body and/or fat mass. Fat is an important nutrient and the diet should contain adequate amounts of fats.

Athletes should aim to achieve carbohydrate intakes that meet the fuel requirements of their training programs and also adequately replace their carbohydrate stores during recovery between training sessions and competition. This can be achieved when athletes eat carbohydrate-rich snacks and meals that also provide a good source of protein and other nutrients. A varied diet that meets energy needs will generally provide protein in excess of requirements. Muscle mass is maintained or increased at these protein intakes, and the timing of eating carbohydrate and protein may affect the training adaptation.

A high carbohydrate intake in the days before competition will help enhance performance, particularly when exercise lasts longer than about 60 minutes. Dehydration impairs performance in most events, and athletes should be well hydrated before exercise. Sufficient fluid should be consumed during exercise to limit dehydration to less than about 2% of body mass. During prolonged exercise the fluid should provide carbohydrate. Sodium should be included when sweat losses are high especially if exercise lasts more than about 2 hours. Athletes should not drink so much that they gain weight during exercise. During recovery from exercise, rehydration should include replacement of both water and salts lost in sweat.

Athletes are cautioned against the indiscriminate use of dietary supplements. Supplements that provide essential nutrients may be of help where food intake or food choices are restricted, but this approach to achieving adequate nutrient intake is normally only a short term option. The use of supplements does not compensate for poor food choices and an inadequate diet. Athletes contemplating the use of supplements and sports foods should consider their efficacy, their cost, the risk to health and performance, and the potential for a positive doping test.

Excessive training and competition are



associated with some negative consequences. Robust immunity and reduced risk of infection can be achieved by consuming a varied diet adequate in energy and micronutrients, ensuring adequate sleep and limiting other life stress. Attention to dietary intake of calcium and iron is important in athletes at risk of deficiency but use of large amounts of some micronutrients may be harmful. Female athletes with menstrual disorders should be promptly referred to a qualified specialist physician for diagnosis and treatment.

Food can contribute not only to the enjoyment of life, but also to success in sport.

Lausanne, 18 June 2003