Food selection and guidance for physically active people

Louise Burke, Ph.D. (Deakin)

Department of Sports Medicine, Australian Institute of Sport, ACT, Australia

The everyday nutritional goals of athletes and physically active people reflect the special, and often increased, nutrient requirements arising from the commitment to regular exercise, as well as the practical challenges of achieving these goals in a busy lifestyle. Issues include achieving and maintaining a body weight and body fat level that is appropriate for optimal sports performance and health, as well as meeting increased requirements for protein and some micronutrients such as iron and calcium. While inadequate intakes of vitamins will impair exercise performance, the current view is that additional vitamin supplementation will not improve exercise performance. Attention to fluid and carbohydrate intake will be an important factor in exercise performance and recovery from exercise, particularly high intensity exercise which is carried out in hot conditions for prolonged periods. Guidelines to promote optimal fluid and fluid intake must be employed before, during and after exercise.

The dietary guidelines of many developed countries which emphasize dietary variety, based on high-carbohydrate, reduce-fat eating, provide an appropriate blueprint for the athlete’s diet. Since sportspersons are well recognized and often hero-worshipped within the community, they provide a worthy example of the potential benefits of a well-chosen diet.

GOAL 1: To achieve and maintain an appropriate body weight and body fat level by balancing energy intake and exercise.

Body fitness is an important risk factor in the development of many of the diseases of affluent societies. Regular physical activity is recommended in community dietary guidelines, for its direct effect on energy balance as well as independent effects on coronary heart disease, non-insulin dependent diabetes, hyperlipidaemia and hypertriglyceridaemia. However, in addition to effects on health and well-being, body fitness plays a role in determining exercise performance in a number of sports. Physically active people who wish to improve their performance or enjoy in a range of sports and exercise pursuits may look to manipulate physique characteristics such as muscle mass and body fatness.

Sports or exercise in which body mass or body fatness

References

are important include those with specific weight divisions for competition (weightlifting, lightweight rowing, boxing, wrestling, judo) and those in which low body mass, and in particular, low percent body fat is considered necessary for optimum performance. The advantages of low body fat levels include physical and mechanical gains, whereby decreases in body fat content lowers the "power to weight" ratio, or simply a reduced amount of "dead weight" that must be moved by the individual. This is a particular advantage in exercise such as distance running, triathlons and road cycling where the individual transports their own body weight. However, low body fat levels are also important for values of aesthetics and appearance in sports such as diving, gymnastics and figure skating. For review, see Browne et al. 4

Although some individuals easily achieve body composition that is suitable to their exercise or sport, others struggle with body compositions such as muscle mass or body fat levels through changes in diet and training. It is important that active people can identify suitable and realistic goals, take appropriate measures to achieve the desired changes in a suitable time period, and to have an appropriate means of measuring the results. 5 Measurements of body weight can not distinguish between muscle mass or body fat, yet very active athletes, as members of the general community, often judge the suitability of their size and body composition by this simple measure. Physically active people might be advised that the only way to determine shorter term changes in hydration (by weighing before and after an exercise session), and thus estimate sweat losses that must be replaced, instead, techniques that assess body fatness such as determination of subcutaneous fat or body weights (the "pinch test") may be used to monitor changes in body composition and help to set desirable levels for individuals.

Loss of body fat should be achieved by a gradual program of sustained and moderate energy deficit that results from a decrease in dietary energy intake and, perhaps, an increase in energy expenditure through training, and are achievable. It appears, however, that even elite athletes are as susceptible as members of the general community to myths and programs that offer false "quick fixes" that promise to reduce fat and improve the safety and health of low body fat are summarised in Table 1.

Table 1. Guidelines for fat loss in the physically active person

1. Identify individual "ideal" body fat and body weight targets that are consistent with good health and physical fitness levels.
2. If loss of body fat is required, plan for a realistic rate of weight loss of about 0.5 kg per week. If a substantial loss is to be undertaken, set both short-term and long-term goals.
3. Exercise with an appropriate and safety activity plans. If your training is primarily skill or technique-based, or is based on brief sessions of very high-intensity exercise, then you may benefit from exercising in some aerobic exercise activities that will encourage fat oxidation. This should always be done in conjunction with your coach. Look also for ways to increase overall expenditure in walking, using stairs, etc.). Many athletes are already sedentary between training sessions.
4. Keep a food diary for a week so that you can take an objective look at what really goes into your mouth. Many athletes who feel that they "hardly eat anything" will find that they may eat far more than they think. When this is the case, an adjustment in caloric intake is likely to be the key to the problem.
5. Reduce your typical energy intake by an amount that is appropriate to produce a negative energy balance. Experts agree that to lose weight, you will need to cut your energy intake in the range of 500-1000 kcal/day. This should be done with a prudent reduction of total fat and calories, the "calorie trap". Do not reduce below 1200-1500 kcal/day. Achieve energy savings by cutting back on unnecessary energy intake. Do not skip meals; rather spread food intake over 4-6 small, regular meals to allow for efficient refuelling after training sessions.
6. Combat situations where you generally overeat. Make meal planning and preparation of choice high-fibre foods. Try to eat out less. Drink plenty of fluids. Spread high intake over the day so that you do not approach meals feeling extreme hunger.
7. Focus energy needs on reducing fat and oils. Choose low-fat versions of nutritious protein foods; minimise added fats and oils in cooking and food preparation, and enjoy high fat snack and sweet foods as occasional treats rather than everyday foods.
8. Alcohol and sugar also represent "empty" Calories, and should also be kept to a prudent level in everyday eating plans. Since alcohol intake causes you to relax, it is often associated with increased food consumption.
9. Be aware of inappropriate eating behaviour, such as eating when bored or upset, or eating too quickly. These are the easiest ways to determine shorter term changes in hydration (by weighing before and after an exercise session), and thus estimate sweat losses that must be replaced. Instead, techniques that assess body fatness such as determination of subcutaneous fat or body weights (the "pinch test") may be used to monitor changes in body composition and help to set desirable levels for individuals.

Table 2. Guidelines for eating to increase muscle mass for the physically active person

1. Ensure you are following a well-balanced, muscle building diet that will stimulate muscle growth and development.
2. Get goals for weight gain and strength that are practical and achievable. Continued increases of 2.4-4.5 kg/month are considered realistic. A general rule of thumb is to consume an additional 5000 kcal/month.
3. Be organised. You will need to apply the same dedication to your eating program that you apply to training. You will need to increase your intake of nutrient dense foods to supply a daily energy surplus of approximately 5000 kcal. This additional food should supply carbohydrate to fuel your training sessions, and adequate protein and micronutrients for the development and support of new tissue.
4. Increase the number of times that you eat rather than the size of meals. This will enable greater intake of food to be consumed without the feeling of ‘‘over stuffing’’ and to assist the process of muscle building. This will require a supply of nutritious high-carbohydrate snacks to be available between meals, particularly after training sessions.
5. Incorporate a daily high carbohydrate foods by adding a little sugar or low-fat protein. For example, add jams and syrups to toast or pancakes, and make two or three sandwiches. This could be achieved by adding kilojoules to a nutritional meal, without adding greatly to the bulkiness of the food.
6. Avoid excessive intake of fibre, and make sure of your "white" cereals with less bulk food, white rice, white bread. You may find it impossible to chew your way through a diet that is solely based on wholegrain and high-fibre foods.
7. Drink high-energy fluids. Make milkshakes and smoothies, or try commercial liquid meal supplements. These drinks provide a compact and low bulk-source of energy and nutrients, and can be consumed with meals or as snacks, including before or after training sessions.
8. If you feel that you are always eating, yet not gaining weight, it is useful to keep a food diary to document your actual intake. Many athletes do not eat as much – or more importantly, as often – as they think. Commitments such as training, sleep, medical/physiotherapy appointments, or school often get in the way of eating opportunities. A food record will identify the hours and occasions of minimal food intake. You should use this information to reorganise your day, or to find ways to maximise food intake and drinks part of the activity.

GOAL: To achieve basic nutrient requirements, including any increase in requirements that arise from a strenuous exercise program.

Whether physically active individuals have increased requirements for protein and micronutrients, and whether increased intakes of these nutrients will improve exercise performance, continue to be points of controversy between athletes and sports scientists. It is generally agreed that increased energy intake due to increased energy requirements will be necessary. In fact, any athlete considering increased food choices, will provide the athlete with nutrient intakes well in excess of the population Recommended Dietary Intakes. Individuals at highest risk of inadequate nutrient intakes are those through pregnancy, those recovering from a weight loss or maintenance diet) and those who limit their food variety (with eating disorders or following vegetarian, or other restrictive diets). It is now agreed that individuals undertaking heavy training (strength or endurance) have increased protein requirements in the order of 1.2-1.6 g/ kg body weight per day, provided that the food also provides adequate carbohydrate and fat intake. 8 However, dietary surveys of a variety of athletic groups show that with increased energy intake, and protein intake at the typical Western level of 12-15% of total energy, there seems little problem in reaching these targets. 1,2,9
are important include those with specific weight divisions for competition (weightlifting, lightweight rowing, boxing, wrestling, judo) and those in which low body mass, and in particular, low body fat levels are considered necessary for optimum performance. The advantages of low body fat levels include physical and mechanical gains, whereby decreases in body fat result in a better “power to weight” ratio, or simply a reduced amount of “dead weight” that must be moved by the individual. This is a particular advantage in exercise such as distance running, triathlons and road cycling where the individual transports their own body weight. However, low body fat levels are also important for values of aesthetics and appearance in sports such as diving, gymnastics and figure skating. For review, see Brownell et al.

Although some individuals easily achieve body composition that is suitable to their exercise or sport, others may find body composition desirable such as muscle mass or body fat levels through changes in diet and training. It is important that active people can identify suitable and realistic goals, take appropriate measures to achieve the desired changes in a suitable time period, and to have an appropriate means of measuring the results. Measurements of body weight can not distinguish between muscle mass or body fat mass, yet many athletes, like members of the general community, often judge the suitability of their size and body composition by this simple measure. Physically active people might be advised that the only way to determine short-term changes in hydration (by weighing before and after an exercise session), and thus estimate sweat losses that must be replaced. Instead, techniques that assess body fatness such as determination of fat mass by calipers (the “pinch test”) may be used to monitor changes in body composition and help to set desirable levels for individuals. 

Loss of body fat may be achieved by a gradual program of sustained and moderate energy deficit that results from a decrease in dietary energy intake and, perhaps, an increase in energy expenditure through leisure and sport. It appears, however, that even elite athletes are as susceptible as members of the general community to myths and programs that offer false solutions. Therefore, those who wish to achieve and maintain a healthy and safe and healthy loss of body fat are summarised in Table 1. 

<table>
<thead>
<tr>
<th>Table 1. Guidelines for fat loss in the physically active person</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identify individual &quot;ideal&quot; body fat and body weight targets that are consistent with good health and performance.</td>
</tr>
<tr>
<td>2. If loss of body fat is required, plan for a realistic rate of loss of about 0.5 kg per week. If a substantial loss is to be undertaken, set both short-term and long-term goals.</td>
</tr>
</tbody>
</table>
| 3. Examine your training and activity plans. If your training is primarily skill or technique-based, or is based on brief sessions of very high-intensity exercise, then you may benefit from inserting in some aerobic or anaerobic exercises that will encourage fat oxidation.  
  This should always be done in conjunction with your coach. Look also for ways to increase energy expenditure in daily walking, washing, stairs, etc.). Many athletes are already sedentary between training sessions. |
| 4. Keep a food diary for a week so that you can take an objective look at what really goes into your mouth. Many athletes who feel that they "hardly eat anything" will be surprised to see the extra food opportunities. |
| 5. Reduce your typical energy intake by an amount that is appropriate to produce loss of body fat (500-1000 kcal per day). Try to strike a balance between reducing energy intake and inactivity, for energy balance will be improved by increasing intake of high-carbohydrate diet foods that will fuel their training sessions. |
| 6. Combat situations where you generally overeat. Make sure that your eating habits are healthy and not associated with stressful or emotional situations. |
| 7. Focus on energy need to reduce intake of fats and oils. Choose low-fat versions of nutritious protein foods; minimise added fats and oils in cooking and food preparation, and enjoy high fat snack and sweet foods as occasional treats rather than everyday foods. |
| 8. Alcohol and sugar also represent "empty" Calories, and should also be kept to a prudent level in everyday eating plans. Since alcohol intake causes you to relax, it is often associated with increased eating. |
| 9. Be aware of inappropriate eating behaviour – such as eating when bored or upset, or eating too quickly. Try to be aware of the time of day and to avoid routine eating when not hungry.  
  Consult a sports dietitian if you are having difficulties with your weight loss goals or would like more specific advice. |
| 10. Consider a low-calorie, low-sodium, mineral supplement if you will be consuming a low energy intake (1200-1500 kcal or less) for a prolonged period. |

Weighing - or more correctly, gain of muscle mass - is desired by many individuals whose exercise activities are limited to size and strength. Greater strength and power may be valuable in weight lifting or throwing sports, in gymnastics, and also in combat and team games such as football codes. Appearance is important in sports such as body building, weight lifting and in team sports such as Association football codes. Additional kilojoules of energy are required for the manufacture of new muscle tissue and other factors needed to support this tissue (additional enzymes, capillaries and connective tissue). The final role protein plays in muscle hypertrophy gains through a program of progressive muscle overload. It is important to realise that these gains are only made as a result of the stimulus of muscle overload, commonly known as strength training, resistance training or weight training programs. The major nutritional requirement to gain muscle mass while undertaking a strength-training program, is additional kilojoules of energy. Additional energy is required for the manufacture of new muscle tissue and other factors needed to support this tissue (additional enzymes, capillaries and connective tissue). The final role protein plays in muscle hypertrophy gains through a program for which muscle protein is a major component. The additional kilojoules of energy required for muscle growth. The role of protein remains the most controversial aspect of nutrition for muscle gain. Scientists on protein metabolism believe that the body can not get in the way of eating opportunities. A food record will identify the hours and occasions of minimal muscle intake. You should use this information to reorganise your day, or to find other ways to make nutritious foods and drinks part of the activity. 

<table>
<thead>
<tr>
<th>Table 2. Guidelines for eating to increase muscle mass for the physically active person</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ensure you are following a well-balanced weight training program that will stimulate muscle development and strength gains.</td>
</tr>
<tr>
<td>2. Set goals for weight and strength gain that are practical and achievable. Continued increases of 2-4 kg/month are not realistic for the bodybuilder.</td>
</tr>
<tr>
<td>3. Be organised. You will need to apply the same dedication to your eating program that you apply to training. You will need to increase your intake of nutrient dense foods to supply a daily energy surplus of approximately 500-1000 kcal. This additional food should supply carbohydrate to fuel your training sessions, and adequate protein and micronutrients for the development and support of new tissue.</td>
</tr>
<tr>
<td>4. Increase the number of times that you eat rather than the size of meals. This will enable greater intake of foods rich in protein and amino acids, thus decreasing muscle loss and muscle catabolism.</td>
</tr>
<tr>
<td>5. Consult a sports dietitian if you are having difficulties with your weight loss goals or would like more specific advice.</td>
</tr>
</tbody>
</table>

Whether physically active individuals have increased requirements for protein and micronutrients, and whether increased intakes of these nutrients will improve exercise performance, continue to be points of controversy between and among athletes and sports scientists. It is generally agreed that increased energy intake due to increased exercise requirements. However, increased energy requirements will also be met by increased food intake, as the provision of both carbohydrate and protein foods, will provide the athlete with nutrient intakes well in excess of the population Recommended Dietary Intakes. Individuals at highest risk of inadequate nutrient intake are those who require three or more meals per day (weight loss or maintenance diet) and those who limit their food variety (eating disorders or following vegetarian, fad or other restrictive diets). 

It is now agreed that individuals undertaking heavy training (strength or endurance) have increased protein requirements in the order of 1.2-1.6 g/kg/day, provided that the diet is high in carbohydrate and protein. However, dietary surveys of a variety of athletic groups show that with increased energy intake, and protein intake at the typical Western level of 12-15% of total energy, there seems little problem in reaching these targets. 

The present consensus on vitamins is that studies have failed to show a beneficial effect of vitamin supplementation on athletic performance, except in the cases of a pre-existing vitamin deficiency. Some individuals, particularly females and those undertaking endurance training. Excess intake may increase energy intake and/ or dietary variety and thus achieve the full nutrient intake potential from food sources. Nevertheless, vitamin and mineral deficiencies are uncommon, but may be chronic low-energy consumers. In such cases, supplementation with a low dose broad range vitamin/mineral supplement may be necessary. 

In conclusion, the best way to maintain and improve exercise performance through the role of iron in oxygen transport (myoglobin and haemoglobin) and in aerobic energy production (cytochromes and other ferro-enzymes). Inadequate iron status may therefore reduce exercise performance. There is a lack of consensus between sports scientists on many issues – for example, the haematological/ biochemical parameters of “optimal” haemoglobin concentration. Haemoglobin concentration may be improved by reducing dietary iron intake and dietary iron absorption, particularly in iron deficient anaemia and exercise performance, and how to distinguish reduced iron status from exercise-mediated changes in iron metabolism. Nevertheless, it is conceded that at least some active individuals are at risk of low iron status due to increased iron requirements (to cover menstrual losses, growth, pregnancy), increased iron losses due to exercise (red blood cell trauma, sweat loss of iron, gastrointestinal bleeding), or poor dietary intake of bioavailable iron. Strategies to maintain iron status include education to improve iron intake and strategies to reduce iron losses. Red blood cell iron absorption is mediated by the consumption of iron-rich foods containing the better-absorbed heme iron from animal foods, as well as strategies to increase the availability of poorly absorbed non-heme iron. Strategies to prevent iron absorption at the same meal and reducing absorption-inhibiting factors such as tannin (tea) and phytates (excess bran fibre) will help absorption. 

Interest in the calcium status of active females has intensified with recent studies reporting low bone density.
and stress fractures in various groups of female athletes. However, the concern should widen to include consideration of eating disorders and the mental status of these athletes, since proof of a link between secondary amenorrhea and reduced bone density has strengthened in recent years. Physically active females are encouraged to follow eating and training programs that maintain regular menstrual status; nevertheless all active individuals should consume diets that provide adequate calcium intake.

GOAL 4: To prevent dehydration during exercise by drinking before, during, and after exercise.

A considerable amount of the energy expended during exercise is lost as heat, and sweating provides the primary mechanism to dissipate heat and maintain temperature. Sweat rates are determined by factors such as the acclimatization period of exercise, exercise intensity and duration, environmental conditions, and can be as high as 1.2-1.8 liters/hour. Dehydration is known to impair exercise performance, particularly prolonged exercise in the heat, when fluid losses exceed 2% of body weight. For good health, improved performance and enjoyment of exercise, the active individual is advised to drink during exercise to help replace sweat and to partly replace lost fluids after exercise. This is especially important in hot environments and during heavy exercise programs where daily sweat losses may exceed 5 liters. Strategies will be needed to achieve such goals, since thirst will not be adequate to gauge acute sweat losses leading to involuntary dehydration. Table 3 provides a summary of such strategies.

Table 3. Guidelines for fluid intake for a physically active individual.

1. Weight changes before and after exercise may give you a guide to sweat losses and your success in replacing these losses during exercise. (A loss of 1 kg is approximately equal to 1 litre of sweat that should be replaced). Check this periodically, more often when you are exercising in very hot conditions.
2. Staying well-hydrated will mean better training. You cannot train your body to “get used to” dehydration or “toughen up”.
3. Begin all exercise sessions well-hydrated. This includes strategies to minimize losses from previous sessions, and having a drink before you start any exercise in hot conditions.
4. Drink during exercise sessions. Previous weight calculations (see point 1) may give you a guide to expected sweat losses. Aim to replace most of this while you exercise; keep net fluid losses below 1-2 kg. Drink early and frequently at a comfortable rate.
5. Organize strategies to have fluid needs on hand during exercise. Practical needs will vary according to the sport or type of exercise. You may need to take a drink bottle with you in “aid stations”.
6. During very strenuous exercise in hot environments sweat losses may greatly exceed reasonable rates of fluid intake. Do the best you can.
7. Choose fluids that are cool and palatable. Remember that sports drinks may allow you to look after fluid and carbohydrate needs simultaneously.
8. Rehydrate fully after exercise with water or carbohydrate-containing drinks. Note that alcohol and caffeine-containing beverages may promote urine production and are not ideal rehydration beverages.

GOAL 5: To provide adequate fuel for exercise activities and to promote recovery between sessions.

A challenge of an exercise program is to provide and replenish fuel used during prolonged exercise, particularly when exercise fuel requirements are substantial and where there may be only 8-24 hours between training sessions. A heavily training athlete may need to set a special schedule of carbohydrate intake to promote optimal recovery, since typical Western eating patterns are unlikely to provide adequate carbohydrate. Failure to consume sufficient carbohydrate to match the demands of training will lead to chronically depleted glycogen stores, which may interfere with optimal training performance and adaptation, and in some cases has been shown to cause overwhelming fatigue in the athlete.

Commencing carbohydrate intake soon after the finish of exercise may be a useful strategy in promoting recovery. The early provision of substrate to the depleted muscle hastens the restoration of muscle glycogen. There is some evidence that the rate of glycogen storage is slightly enhanced by increased muscle cell sensitivity during the first 1-2 hours after exercise. It has been recommended that 1.5-3.0 g/kg body weight of carbohydrate be consumed as soon as possible after the cessation of a prolonged exercise bout.

Nutrition guidelines for individuals undertaking a general exercise program recommend that carbohydrate intakes should be increased above the levels currently typical of the Western diet (55% of total energy intake) and this should be achieved primarily by increasing the consumption of complex carbohydrate and fibre-containing food. These recommendations are similar to healthy nutrition guidelines aimed at the general population. In the case of the heavily training athlete, carbohydrate intake guidelines have been set in order to maximise the capacity for daily glycogen restoration. These recommendations have been made both on the basis of absolute carbohydrate intake (8-10 g/kg body mass per day) or as a contribution to total energy intake (65-70% of total energy).

The focus of this chapter is on carbohydrates-rich foods may assist the athlete to meet requirements for other nutrients simultaneously. Nevertheless, sugar and refined carbohydrate foods offer the advantages of being compact and pleasant to eat, and can provide a useful but smaller contribution to the athlete’s total carbohydrate intake. Liquid sources of carbohydrate may also provide a compact and practical way to help achieve the very high carbohydrate requirements of some individuals in heavy training.

These attributes may be most appreciated during or immediately after exercise. Under these conditions intake of carbohydrate during exercise has been identified as an important strategy for promoting endurance and reducing fatigue during prolonged aerobic performance. Numerous studies have reported benefits to performance when carbohydrate is consumed during prolonged exercise events. Both solid foods and carbohydrate drinks have been successfully used to supply carbohydrate during exercise, but drinks are preferred because of the decreased risk of gastrointestinal side-effects, and the consideration of fluid requirements. The commercially available sports drinks, 5-7% solutions of various simple carbohydrates, provide a simple way for a physically active person to look after fluid and carbohydrate considerations during most exercise situations. Table 4 provides guidelines for carbohydrate intake for the physically active individual.

Table 4. Guidelines for high carbohydrate eating for a physically active individual.

- Base meals and snacks around nutritious carbohydrate foods. Let these foods take up at least half of the room on your plate
  - wholegrain breads and breakfast cereals – rice, pasta, noodles and other grain foods
  - fruits
  - starchy vegetables such as potatoes and corn
  - legumes (lentils, beans, soy-based products)
  - sweetened dairy products such as fruit flavoured yoghurt and milkshakes
  - "Carbo-load" don’t "carbo-load". Many of the foods commonly believed to be high in carbohydrate are actually high in fat or provide few ideas, and promote fuel foods rather than high-fat foods.
  - Make good use of compact sugar and sugar-based foods, especially when added to a nutritious high-carbohydrate meal, or when needed during and after exercise.
  - Carbohydrate drinks are also a compact source for special situations or very high-carbohydrate diets.

Louise Burke Asia Pacific J Clin Nutr (1995) 4 Suppl 1

Food selection and guidance for physically active people

Category includes many of the supplements made specifically for athletes – such as sports drinks, high carbohydrate powders and liquid meal supplements.

5. Eat a high-carbohydrate meal or snack within 15-30 minutes of lengthy training sessions to speed glycogen recovery.

7. Consume carbohydrate during lengthy training and competition sessions when additional fuel is needed. Sports drinks and other sugary drinks will look after fluid and carbohydrate needs simultaneously, with sports drinks being specially designed to rapidly deliver these nutrients.

GOAL 6: To incorporate nutritional practices that promote long-term health, and reduce the risk of chronic disease patterns of affluent Western countries.

The community nutrition education programs of many countries include dietary guidelines that not only address nutrient adequacy, but deal with long-term health and the dietary factors implicated in the development of the chronic health problems of Western society. These guidelines recommend a reduced intake of fats and oils, increased intake of nutritious carbohydrate and fibre foods, and moderation with salt, sugar and alcohol intake. These principles are identical to those outlined in this article for optimal training nutrition. While this provides further incentive to the physically active to follow a healthy training diet, we should also be aware of the opportunity for such people to provide role models for the community. Since sportspersons are well-educated and often hero-worshipped within the community, they provide a worthy example of the potential benefits of a well-chosen diet.
Food selection and guidance for physically active people

8. Rehydrate fully after exercise with water or carbohydrate-containing drinks. Note that alcohol and caffeine-containing beverages may promote urine production and are not ideal rehydration beverages.

GOAL 5: To provide adequate fuel for exercise activities and to promote recovery between sessions.

A challenge of an exercise program is to provide and replenish fuel used during prolonged exercise, particularly when exercise fuel requirements are substantial and where there may be only 8-24 hours between training sessions. A heavily training athlete may need to set a special schedule of carbohydrate intake to promote optimal recovery, since typical Western eating patterns are unlikely to provide adequate carbohydrate. Failure to consume sufficient carbohydrate to match the demands of training will lead to chronically depleted liver and muscle glycogen stores. The athlete may interfere with optimal training performance and adaptation, and in some cases has been shown to cause overwhelming fatigue in the athlete.

Commencing carbohydrate intake soon after the finish of exercise may be a useful strategy in promoting recovery. The early provision of substrate to the depleted muscle hastens the restoration of muscle glycogen. There is some evidence that the rate of glycogen storage is slightly enhanced by increased muscle cell sensitivity during the first 1-2 hours after exercise. It has been recommended that 1-5 g/kg body weight of carbohydrate be consumed as soon as possible after the cessation of a prolonged exercise bout.

Nutrition guidelines for individuals undertaking a general exercise program recommend that carbohydrate intakes should be increased above the levels currently typical of the Western diet (55% of total energy intake) and should be achieved primarily by increasing the consumption of complex carbohydrate and fibre-containing foods. These recommendations are similar to healthy nutrition guidelines aimed at the general public. In the case of the heavily training athlete, carbohydrate intake guidelines have been set in order to maximise the capacity for daily glycogen restoration. These recommendations have been made both on the basis of absolute carbohydrate intake (8-10 g/kg body mass per day) or as a contribution to total energy intake (65-70% of total energy).

The focus on nutritious carbohydrate-rich foods may assist the athlete to meet requirements for other nutrients simultaneously. Nevertheless, sugar and refined carbohydrate foods offer the advantages of being compact and pleasant to eat, and can provide a useful but smaller contribution to the athlete’s total carbohydrate intake. Sources of carbohydrate may also provide a compact and practical way to help achieve the very high carbohydrate requirements of some individuals in heavy training.

These attributes may be most appreciated during or immediately after exercise. Reducing the consumption of carbohydrate during exercise has been identified as an important strategy for promoting endurance and reducing fatigue during prolonged aerobic performance. Numerous studies have reported beneficial performance when carbohydrate is consumed during prolonged exercise events. Although both solid foods and carbohydrate drinks have been successfully used to supply carbohydrate during exercise, carbohydrate drinks are favoured because of the decreased risk of gastrointestinal side-effects, and the consideration of fluid requirements. The commercially available sports drinks, 5-7% solutions of various simple carbohydrates, provide a simple way for a physically active person to look after fluid and carbohydrate considerations during most exercise situations. Table 4 provides guidelines for carbohydrate intake for the physically active individual.

Table 4. Guidelines for high carbohydrate eating for a physically active individual

1. Be prepared to be different -- a Western diet is not a high-carbohydrate diet.
2. Base meals and snacks around nutritious carbohydrate foods. Let these foods take up at least half of the room on your plate
   - wholegrain breads and breakfast cereals – rice, pasta, noodles and other grain foods
   - fruits
   - starchy vegetables such as potatoes and corn
   - legumes (lentils, beans, soy-based products)
   - sweetened dairy products such as fruit flavoured yoghurt and milkshakes
3. "Carbo-load" don't "carbo-load". Many of the foods commonly believed to be high in carbohydrate are actually high in fat or need to be eaten in moderation and included in meals, and promote fuel needs of high-fat foods.
4. Make good use of compact sugar and sugar-based foods, especially when added to a nutritious high-carbohydrate meal, or when needed and during and after exercise.

Carbohydrate drinks are also a compact source for special situations or very high-carbohydrate diets. This category includes many of the supplements made specially for athletes -- such as sports drinks, high-carbohydrate powders and liquid meal supplements.

6. Eat a high-carbohydrate meal or snack within 15-30 minutes of lengthy training sessions to speed glycogen recovery.

7. Consume carbohydrate during lengthy training and competition sessions when additional fuel is needed. Sports drinks and other sugary drinks will look after fluid and carbohydrate needs simultaneously, with sports drinks being specially designed to rapidly deliver these nutrients.

GOAL 6: To incorporate nutritional practices that promote long-term health, and reduce the risk of chronic disease patterns of affluent Western countries.

The community nutrition education programs of many countries include dietary guidelines that not only address nutrient adequacy, but deal with long-term health and the dietary factors implicated in the development of the chronic health problems of Western society. These guidelines recommend a reduced intake of fats and oils, increased intake of nutritious carbohydrate and fibre foods, and moderation with salt, sugar and alcohol intake. These principles are identical to those outlined in this article for optimal training nutrition. While these provides further incentive for the physically active to maintain a healthy training diet, we should also be aware of the opportunity for such people to provide role models for the community. Since sportspersons are people who are often hero-worshipped within the community, they provide a worthy example of the potential benefits of a well-chosen diet.

Louise Burke

Asia Pacific J Clin Nutr (1995) 4, Suppl 1

Food selection and guidance for physically active people

1. Use the appropriate amount of fats when preparing meals. Use only a little or none. Use unsaturated fats for cooking.
2. Use the appropriate amount of carbohydrates when preparing meals. Use moderate amounts. Use a variety of sources.
3. Use the appropriate amount of proteins when preparing meals. Use moderate amounts. Use a variety of sources.
4. Use the appropriate amount of vitamins when preparing meals. Use moderate amounts. Use a variety of sources.
5. Use the appropriate amount of dietary fibre when preparing meals. Use moderate amounts. Use a variety of sources.
6. Use the appropriate amount of minerals when preparing meals. Use moderate amounts. Use a variety of sources.
7. Use the appropriate amount of water when preparing meals. Use moderate amounts. Use a variety of sources.
8. Use the appropriate amount of salt when preparing meals. Use moderate amounts. Use a variety of sources.
9. Use the appropriate amount of sugar when preparing meals. Use moderate amounts. Use a variety of sources.
10. Use the appropriate amount of alcohol when preparing meals. Use moderate amounts. Use a variety of sources.
11. Use the appropriate amount of caffeine when preparing meals. Use moderate amounts. Use a variety of sources.
12. Use the appropriate amount of energy when preparing meals. Use moderate amounts. Use a variety of sources.
13. Use the appropriate amount of emotion when preparing meals. Use moderate amounts. Use a variety of sources.
14. Use the appropriate amount of pleasure when preparing meals. Use moderate amounts. Use a variety of sources.
15. Use the appropriate amount of satisfaction when preparing meals. Use moderate amounts. Use a variety of sources.
Diet and dental caries

Stephen H.Y. Wei, DDS, MS, MDS, FRACDIS, FICD, FACD, FDSRCS (Eng)

Professor of Children's Dental Health and Orthodontics Dent, Faculty of Dentistry, The University of Hong Kong, Hong Kong

Dental caries prevalence is on the increase in transitional societies in the same way as chronic non-communicable diseases, having been largely controlled in developed societies. The lessons of dietary carcinogenicity and preventive strategies, through dietary hygiene and fluorides are still to be incorporated into the health policies and practices of many countries, and applied to risk populations, like immigrants, in developed nations. Preferred fluoride delivery systems are under active discussion. There is particular concern about nursing practices in early life, and, in later life, adequacy of dentists and the problems of plagiocarve need to be addressed.

Diet and dental caries

Dental caries is one of the most prevalent diseases in children. It is a multifactorial disease requiring the presence of a susceptible tooth, cariogenic microflora (plaque), and a diet conducive to enamel demineralization. The classic diagram of the etiology of dental caries is shown by four overlapping circles indicating the concurrence of etiologic factors. To prevent or arrest dental caries it requires that only one factorial parameter of concurrence.

Dental caries is a disease that dates back to antiquity and occurs in populations that have never used sugar or processed foods. The prevalence of dental caries appears to increase with civilization, urbanization, and affluence. There is presently an alarming rate of increase in the prevalence of dental caries in developing countries. The introduction of sucrose into the modern diet has been associated with increased caries prevalence. However, most developed countries have seen a significant and continuing reduction in caries prevalence in the last 30 years.

The concept held by practicing dentists regarding the relationship between diet and dental caries is sometimes characterized by the equation:

Bacterial enzyme + Fermentable carbohydrate = Acid
Acid + Tooth = Cavity (over time)

This concept has spurred some dentists to advocate a simplistic approach based solely on the elimination of sugar. In fact, the relationship between the numerous dietary factors and dental caries is complex, and may be more appropriately represented by the following hypothetical formula:

Caries expression = [Bacterial virulence] x [Saliva Buffering capacity] x [Host resistance] x [Food effects]
Chemistry of tooth substance = [Chemistry of tooth substance] x [Oral retention of food] x [Stickness] x [Food acidity] x [Food texture]

Epidemiological studies

Modern diet versus primitive diet

Epidemiological studies have shown that the incidence of dental caries differs immensely among population groups. Although part of the variance can be attributed to genetic factors, the diets of different ethnic groups probably account for the major differences.

Skeletal remains from preagricultural cultures show that dental caries incidence is much lower. For example, the caries prevalence of ancient Hawaiians was extremely low, especially throughout childhood and early adulthood. In older members (40 years and older) it usually increased due to cervical root caries complicated by concurrent periodontal disease. By contrast, the children in Hawaii today have one of the highest dental caries incidence rates in the USA. The dental caries prevalence in children in France and the Netherlands has also been found to be relatively high.

Dental caries incidence in native populations

Correspondence address: Dr. W.B. O'Connell, Director of Dentistry, The University of Hong Kong, Ping Shan, Hong Kong. Tel: +852-8547-6257 Fax: +852-8547-6257