

Nutritional Requirements for Health and Performance

By Karen Inge, BSc Dip Diet FASMF, Sports Dietitian.

Introduction

It is now well accepted that nutrition plays a vital role in sporting performance. Athletes today are aware that their diet will affect their performance. More emphasis is being placed on the daily replenishment of fuel stores and the maintenance of optimal nutrition status than in the past where the focus was simply to pre-event eating. We are entering an exciting phase in sports nutrition research where we are beginning to understand that athletes' dietary requirements are different to the normally active population.

Carbohydrate

Meeting carbohydrate needs is crucial to athletes yet many athletes find this hard to do. The work of Costill, Coyle, Sherman and others over the last 20 years has clearly shown that unless adequate carbohydrate is consumed on a daily basis between training sessions, muscle glycogen content will gradually decline. As research has suggested, the gradual and chronic depletion of glycogen may decrease endurance and exercise performance. It is recommended that heavily training athletes consume 7-10 grams of carbohydrate per kilogram of body weight per day ... ie. >60% of total kilojoules...to help prevent daily carbohydrate depletion.

We now also know that the most rapid synthesis of glycogen occurs immediately following prolonged exercise and that this rate slows overtime. To take advantage of this, athletes should consume a carbohydrate meal or snack as soon as possible after completion of prolonged exercise to promote rapid storage of muscle glycogen. This carbohydrate-rich meal or snack should provide 1-2 grams of carbohydrate per kilogram body weight, and this should be repeated every two hours until the normal eating pattern is resumed. Different types of carbohydrates appear to have different effects on synthesis of muscle and liver glycogen. Glucose and sucrose feeding after prolonged exercise have been reported to produce similar rates of muscle glycogen recovery whereas the intake of fructose produces a much lower rate of muscle storage. Fructose however, leads to a greater rate of live glycogen synthesis when compared to glucose. Therefore, foods with a high fructose content should be included in the recovery diet. Research I now concluding that carbohydrate4s with a moderate to high glycaemic index (GI) should take priority in the recovery diet, as these provide greater glycogen storage than an equal amount of carbohydrate eaten in the form of low GI foods.

Fat

Generally, an excessive fat intake goes hand in hand with inadequate carbohydrate intake. Athletes, who struggle to meet carbohydrate needs, are often filling up on high fat foods. To achieve their appropriate intake of carbohydrate, the high intakes of fat must be reduced to lower levels. The recommendation for the general population is to reduce fat intake to 30% or less of total kilojoules, but for athletes we recommend much lower levels of dietary fats.

Protein

Although protein requirements are greater in athletes, the high-energy intakes consumed by many athletes result in a higher protein intake, along with the expected increase in carbohydrate intake. An athlete's protein requirements will easily be met if 12-15% of total energy is from protein of 1.2-1.6g Pro/kg body weight for strength training athletes and 1.2-1.7g Pro/kg body weight for endurance trained athletes. Many athletes are convinced that very high intakes of protein or individual amino acids might enhance exercise performance. Branched Chain Amino Acids (BCAAs)... ie. Valine, leucine and isoleucine... are one group of amino acids marketed as a supplement to athletes. During prolonged exercise there is a gradual fall in plasma levels of BCAAs and an increase in tryptophan, which results in an increase in brain serotonin and central fatigue.

Supplementation of these BCAAs has been suggested as a counter. Studies with endurance athletes using BCAA supplementation have been inconclusive. An interesting finding by Davis et al in 1992, (1) was that carbohydrate feeding attenuates the increase in they tryptophan to BCAA ratio during prolonged exercise.

Vitamins

A group of vitamins that have received particular attention to recent years are the anti-oxidant vitamins, vitamins C, E and pro vitamin A (beta-carotene). Physical activity produces an increase in oxygen consumption and, as oxygen use increases, so too does the production of oxygen-free radicals which is associated with oxidative damage and muscle injury.

Some evidence exists that anti-oxidants decrease indices of tissue damage following endurance exercise by lowering the free radical burden associated with strenuous exercise.

Further research is required before we recommend anti-oxidant supplements to athletes. Until then, it is important that athletes eat plenty of fruits, vegetables and wholegrain cereals to optimize their dietary intake of anti-oxidants.

Iron

Iron deficiency is commonly reported in athletes undergoing heavy training and can adversely affect performance. The deficiency may be due to an inadequate intake of dietary iron or an increased loss associated with exercise or both. Athletes are likely to lose iron through sweat, urine, gastrointestinal bleeding or from injury associated with blood loss.

Suboptimal dietary intake may occur in those athletes on low energy diets, vegetarian diets, natural food diets or fad diets. Due to the high iron requirements of many athletes it can be difficult to meet iron needs.

Calcium

Inadequate diet, strenuous training at a young age and low body fat levels are risk factors for amenorrhoea (irregular or absent menstrual cycle) and osteopenia (reduced bone mass) which appear to increase the risk of developing more fragile bones and stress fractures.

The childhood, adolescent and teen years are the most critical time for bone growth both in terms of length and strength. During this period of growth and development, bone formation exceeds bone loss and there is a net increase in bone mass which peaks in the early twenties.

If we take a closer look at what happens in these years leading up to the attainment of peak bone mass, we can see that the greatest increase in bone accrual occurs at puberty. One could conclude that if young athletes do not go through puberty and menarche, they might not experience this estrogen-related increase in bone formation.

However, studies by Bass are showing that pre-pubertal gymnasts have accrued significantly larger amounts of bone ... ie. They have greater bone mineral density... compared to non-gymnastic girls. This places them in a position to gain high peak bone mass in adulthood and reduce the risk of osteoporosis later in life. The current recommendation for amenorrhoeic female athletes is to increase their calcium intake to approximately 1500mg per day.

Hydration

The effects of dehydration can be debilitating and extremely dangerous, so it is of vital importance that athletes prevent this from occurring. It is essential that athletes prevent this from occurring. It is essential that athletes drink enough fluid to replace the amount of fluid lost through sweat. The amount of fluid required varies considerably as sweat rates depend on several factors including the size of the athlete, degree of acclimatization, the intensity of the exercise and the environmental conditions. A good guide is for the athletes to weigh themselves pre and post training. Every kilogram of weight lost represents approximately one litre of fluid.

Water is one of the best fluids to replace sweat losses during training. However, sports drinks are also ideal, offering several other benefits. In addition to fluid, they supply carbohydrate to top up blood sugar levels during exercise and promote recovery after exercise. Most drinks provide 6-8% carbohydrate, which results in optimal gastric emptying. In addition to this, they provide electrolytes: sodium and potassium. Potassium in the drinks replaces sweat losses and the sodium enhances intestinal absorption of the fluid. Research has also show that athletes will drink more of a flavoured drink compared with a non-flavoured one.

Competition Diet

There are a number of important dietary considerations leading up to a competition. It is important that the training diet has provided adequate amounts of carbohydrate to maximize muscle and liver glycogen stores and that the athlete is in a well hydrated state.

Prior to the competition there are some important guidelines to follow to enhance performance. The pre-event meal will add little to glycogen reserves, but it will replenish blood glucose levels, which is also important. Ideally, athletes should compete on an empty stomach; therefore the timing of the meal is important. Two to three hours before competition is a good time to eat a high carbohydrate meal. The meal should also be low in fat as it takes longer to digest. It is also important to eat a meal that is familiar. The training period should be used to determine what works best for the athlete. Swimmers competing in several events over the day should have regular carbohydrate snacks and fluids between events to keep their carbohydrate and fluid levels up. If breaks are longer than 1 ½ -2 hrs, the athlete should try to consume some solid foods. If breaks are shorter than this, replacing fluid losses is a priority. Sports drinks are useful as not only will they benefit hydration but will also provide a source of energy.

Further Reading

- Clinical Sports Nutrition – Louise Burke and Vicki Deakin
- The Complete Guide to Food for Sports Performance – Dr Louise Burke
- Food for Sport Cookbook – Karen Inge and Christine Roberts
- Food, Fitness and Feeling Good – Karen Inge
- Gold Medal Nutrition – Glenn Cardwell
- Taste of Fitness – Helen O'Connor and Donna Hay