



## Nutrition and the winning edge

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### ABSTRACT

Strenuous physical activity is part and parcel of an athlete's daily schedule especially prior to competitions. The physical demands of training induce specific nutritional demands in the athlete as sports training is often characterised by acute bouts of high power output (Brotherhood, 1984) which inevitable places a huge demand for energy and water. This posits that proper nutrition is a vital aspect in sports and can optimize one's performance on the track or field. Over the past two decades, there has been greater understanding on the inextricable link between dietary behavior and optimal sports performance. Yet, awareness on the ground still seems to be lacking especially in developing nations. This paper, hence, attempts to summarize some important concepts pertaining to nutrition and sports performance to raise awareness on the physiological basis of the specific nutritional demands of sporting activities. It also provides some suggestions on dietary composition during various stages of training and competition.

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### Introduction

In the context of this paper, *nutrition* is defined as the science that studies food and how food nourishes our bodies and influences our health. It involves studying how we consume, digest, metabolize, and store nutrients and how these nutrients affect our bodies (Thompson, 2005). Proper nutrition improves our health and prevents certain diseases. It also helps us to achieve and maintain a desirable weight, and provide energy and vitality for our daily need. Furthermore, adequate nutrition is essential for optimal recovery between workout and maximal adaptation to training programs among athletes.

Currently there is a vast amount of literature on the importance of a proper nutrition for peak performances in sports. This is a result of extensive research conducted on the relationship between nutrition and performance. Basically, to improve performance, athletes must eat sufficient amounts of all the nutrients and not just carbohydrate as research indicates that no one food or nutrient can optimize athletic performance.

Thus, we argue that all athletes must consume proper amounts of carbohydrates, fats, proteins, vitamins, minerals and water during all levels of their training schedule leading to the various competitions they are participating in. More importantly, an athlete's dietary habit affects their energy storage and recovery capacity which can impact their performance. In other words, athletes undergoing training in various sports can get more out of the training sessions by having a proper diet that complements their training. In this sense, it must be noted that the energy demands vary according to the type, duration, and intensity of the activity being performed.

Although there is greater emphasis on proper nutrition in sports in Malaysia nowadays, it must be noted that there are also many misconceptions and controversies that ought to be addressed. One such misconception is that it is important to consume food supplements during training to obtain the adequate amount of nutrients. This is untrue, as the best form of nutrients for the body are those obtained via one's daily diet rather than food supplements. We believe that such

misconceptions and controversies must be addressed and a greater awareness on sports nutrition must be inculcated among those involved in sports.

### Nutrients in the food

Athletes must eat a variety of nutritious foods that provide fuel and protein for the body. Fats and carbohydrates stored in the body provide the energy that an athlete needs to perform at his or her best while water is critical to prevent dehydration that may cause muscle cramps. Dehydration will also result in fatigue during any form of physical exertion. Hence, it is vital that a proper and well balanced dietary plan is incorporated as part of the athlete's training program.

### Carbohydrates

The most nutritional benefit for athletic performance comes from carbohydrates which provide up to 50 percent of the energy required for initial moderate exercise and yield more energy per unit of oxygen than fats. Foods that provide complex carbohydrates that an athlete needs for peak performance include potatoes, cereals and grains. The body reduces carbohydrates to glucose (sugar) and stores it in the muscles as glycogen. Studies have indicated that the muscles can store enough glycogen to sustain vigorous exercise for no more than 90 minutes.

Basically, the glycogen is converted back to glucose and is burned for energy during physical exercise. If an athlete anticipates sustained exercise for more than 90 minutes, a high carbohydrate diet should be consumed for three days prior to the event so that the maximum amount of glycogen can be stored in the muscles. Carbohydrates are an important energy source for human metabolism and athletic performance. Dietary carbohydrates contain 4 kcals of energy per gram and functions primarily as energy substrate. They play the major role in supplying the brain and body with fuel.

Food rich in carbohydrates that breakdown quickly during digestion may provide immediate benefits to athletes during training and competition. In sports, this is determined by easing the effect of the type of food on the blood glucose

level or the glycemic index, immediately after consumption. The index value is based on the glycemic effect of pure glucose. The body's response to carbohydrate meals, i.e. when there is a rise in blood sugar, is called the glycemic response. Knowledge of the glycemic index and glycemic response is important as its effective utilization during training and competition, can help improve performance.

For example, food with a high glycemic index can cause sudden large increase in blood glucose, triggering an increase in insulin, which may be followed by a dramatic fall in blood glucose. Alternatively, food with a low glycemic index causes low to moderate fluctuations in blood glucose. The table below provides some examples of food and their respective indexes:

**Table 1; Glycemic Index and types of food**

No.	Glycemic Index	Types of food
1	Low	Oatmeal, wholemeal bread, kidney beans
2	Medium	Banana, white rice
3	High	Instant mashed potatoes, jelly beans

Carbohydrates are also stored in muscle and liver tissues. The storage form of carbohydrate is known as glycogen and is utilized during high intensity activities. The glycogen in the muscle is used directly by the muscle that is being exercised. When exercising hard for extended periods, there is a continual loss of glycogen from the active skeletal muscle. When glycogen stores become depleted, the athlete will not be able to exercise at a high level and will experience fatigue. Chronic fatigue limits an athlete's ability to train properly and therefore cannot compete at maximal potential. Consuming carbohydrates during endurance exercise can postpone fatigue and prolong optimal performance by providing an external source of carbohydrate.

The amount of glycogen that is stored in the body depends partly on the amount and type of carbohydrate in the diet and the type of exercise being performed. Repetitive training also helps in the storage of glycogen by stimulating muscles to store more carbohydrate and by improving the body's utilization of food as fuel. Carbohydrates are the best fuel for athletes because they take less oxygen to burn than protein or fat. Simple carbohydrates such as sugars, candies, baked desserts and sodas and other highly sweetened drinks provide empty calories that supply no vitamins and minerals. So, it is complex carbohydrates such as starch and fiber that should make up the biggest percentage of the carbohydrate diet ranging from 55 to 70% of total calories consumed.

Endurance athletes and those that train intensely on successive days are likely to require 65-75% of calories from carbohydrates to optimize performance. The table below indicates the recommended carbohydrate intake goals in relation to various kinds of situations.

**Table 2: Recommended carbohydrate intake by the Australian Institute of Sports (2001)**

Situation	Recommended carbohydrate intake
>60-90 min per day or low intensity exercise	5-7g per kg Body mass
90-120 min per day	7-10 g per kg BM
Pre-event meal	Meal eaten 1-4 hours pre-competition 1-4 g per kg BM
Carbohydrate loading for endurance and ultra-endurance events	Daily intake 7-10 g/kg BM
Carbohydrate intake during training sessions and competition > 1 hr	1g per min or 60g / hour
Rapid recovery after training session or multi-day competition, especially when there is < 8 hrs until next session	1g/kg BM in the first 30 min after exercise, repeated every 1-2 hrs until the regular meal pattern is resumed

## Protein

Dietary proteins are essential nutrients that the body uses for synthesis of tissue protein and other metabolic functions. They are required for growth and to provide the body with energy. The body also uses proteins from the diet for the production of red blood cells, to boost the immune system, and for the formation of enzymes, hormones and various fluids and body secretions. Proteins are used as an energy source when amino acids are converted to glucose during aerobic exercise, but it is primarily used by the body to build and repair tissue. Protein can also be used for energy production and may provide up to 10% of the total energy produced during long-duration activity.

Proteins are made up of chains of amino acids that differ in structure and by their ability to be synthesized by the body. Our bodies have the capability to synthesize certain amino acid called non-essential amino acid. An absence or inadequate intake of any one of the essential amino acids can lead to negative nitrogen balance, weight loss, impaired growth and clinical symptoms. An athlete's protein requirements depends on a number of factors such as whether he or she is still in the developmental and muscle-building stage or needs proteins for endurance activities or dieting in which case the protein becomes the source of energy.

Basically, athletes need a protein-intake of more than RDA of 0.8 gm of protein / kg BM while athletes in high-endurance events and activities need a protein intake of 1.2g/kg per day. Male bodybuilders and strength athletes need a even higher protein intake at 1.6.to 1.7 g/kg BM per day to allow for the accumulation and maintenance of lean tissue.

Despite the overwhelming importance of proteins in an athlete's diet, protein supplementation is not necessary at all because enough protein can be obtained through a proper well-planned diet. Furthermore, protein supplements can be a waste as excess proteins are broken down and may be converted to fats or used as energy. In addition, consuming more than 2.0g/kg BM/day will cause an increase in amino acid oxidation without increasing whole body protein synthesis. As a result, excess nitrogen from the breakdown of protein will be left circulating in the body, which needs to be excreted through urine. This process requires water from the body and can lead to dehydration.

Protein is the toughest nutrient to digest, so the body expends a lot of energy breaking it down and absorbing it for use. Hence high protein foods such as lean meat, eggs and low fat milk (from animal sources) should be avoided or limited before training or competition. Instead, plant protein sources such as brown rice and beans, consumed together, are a better substitute.

## Fats

Fats are an efficient storage form of energy for the body. They contain 9 kcals per gram and are made up of chains of fatty acids. They can only be oxidized or broken down aerobically with the presence of oxygen.

Generally, fats are considered as an essential nutrient that plays many critical roles in the maintenance of health of the human body. It also provides energy for the cells, especially during endurance activities. There are two types of fats i.e. saturated and non-saturated fats. Examples of saturated fats are whole milk, cream, butter, cheese, fatty meats and coconut oil. Saturated fat in the diet should be limited, as they are known to raise blood cholesterol levels.

Fats are also known to replenish muscle triglyceride stores after high intensity exercise, enhance immune function and improve the hormonal environment for optimal recovery.

### Vitamins

Vitamins do not supply calories. These nutrients provide fuel for the body, just like how gasoline provides fuel for cars. They also help control the growth of body tissue and can be obtained from the food that makes up a typical daily diet. Thus, athletes can obtain all the vitamins they need by including a wide variety of food in their diet. For example an athlete can get almost 100% of the required vitamin C from just one glass of orange juice.

### Minerals

Like vitamins, minerals do not supply calories but are involved in an endless number of jobs in the body. Primarily, minerals build cells and control bodily processes. Important minerals include calcium, iodine, iron and phosphorus. An athlete can automatically increase his or her mineral intake by eating a wide range of food from all the five food groups.

### Water and Body Fluid Balance

A sports diet is qualitatively similar to a diet of a healthy adult. Its main aspects are meeting the energy and fluid requirements, which in contrast to sedentary people can vary to a large degree in sportsmen. The relative contribution of the macronutrients to the energy consumption should make up 55 to 60% carbohydrates (mainly derived from low glycemic food), 10 to 15% protein, and 25 to 30% fat. The main focus of a diet for most recreational sport activities should be on an optimal carbohydrate and fluid intake, which are the two main limiting factors of most physical activities. Related to the body mass, the carbohydrate intake should amount to 5 to 7 grams per kilogram. During the days before and after an intense exercise session or competition, however, the intake should be raised to about 10 grams per kilogram body mass to ensure an optimal energetic preparation of and regeneration from the exercise bout. The water intake should be about 2 to 3 liters per day with an extra 1.2 to 1.5 liters to balance each liter of exercise-induced sweat loss.

As it is widely known, fluids are crucial for all bodily functions. They are important to:

- replace water loss during exercise
- avoid reduction in performance due to dehydration
- help maintain core body temperature
- deliver carbohydrates during prolonged exercise
- provide electrolytes (sodium and potassium) lost through sweat

If adequate fluid intake is neglected, dehydration which can affect an athlete's performance may occur. As such, an awareness of the fluid balance in the body is important for athletes. For example, many athletes are known to rely on their thirst for water as an indicator that water is needed by their body. However, thirst is not a good indicator of how much fluid an athlete needs. Generally, athletes lose more than three litres of fluid in a day of training or competition through the respiratory and excretory systems. So, they need to replenish their bodily fluids regularly and systematically, instead of relying on thirst, to avoid dehydration.

The following guidelines can minimize the threat of dehydration:

- Drink 1 to 2 cups of fluids (250-500ml) prior to working out or competing
- Drink 125-250ml of fluids every 15-20 minutes of training

- Avoid carbonated drinks, which can cause gastrointestinal distress and may decrease the volume of fluids consumed.
- Avoid caffeine which can contribute to fluid loss.

Some athletes rely on branded "sport drinks" for their fluid intake as they contain the necessary minerals to replace the ones lost while sweating and so on. However, it is an expensive option for athletes who train daily or several times per week. An alternative is to prepare a home-made sports drink which costs very little to produce.

#### Homemade sports Drink (Ingredients per litre)

- 30g of table sugar
- 30g of glucose powder (can be bought from pharmacies)
- 2g of salt (1/2 a teaspoon)
- Some sugar-free cordial (for flavouring)

To make 500mls, use only half the amount of ingredients, while double the quantity of ingredients to make 2 litres. (Source: Swimming & Nutrition, City of Bradford swimming club)

### Nutrition during training

The training phase is the actually the period in which athletes spend most of their time and energy. Therefore, this paper views this phase as the most critical period. During this phase, a diet which is rich in carbohydrates is extremely important. This is because athletes who train between 4-6 hours a day are likely to burn between 2500 to 4000 calories. Thus, the best way to replenish the lost calories is with a high carbohydrate diet.

This paper recommends that three main meals supplemented by 2 or 3 snacks are taken daily as illustrated below:

- Breakfast
- Mid morning (Training diet)
- Lunch
- Mid afternoon (Training diet)
- Dinner
- Supper

### Pre-competition nutrition

The major purpose of the pre-event diet is to ensure sufficient energy and fluid for the athlete. Two to three days before competition, a high carbohydrate with plenty of fluids is recommended. The ideal amount of carbohydrates in the pre-competition meal should be around 50-60 grams (200-300 calories) and should be consumed 3 to 4 hours prior to the event. In addition, drinking small amounts of a well-formulated sports drink or sports bar an hour before competition is also recommended. If proper nutrition guidelines are followed, the pre-competition meal will be able to:

- help the athlete avoid hunger during competition.
- stabilize blood sugars before and during competition
- add energy to complement existing glycogen store.
- pre-hydrate or hydrate the athlete
- prevent gastrointestinal distress
- provide a relatively empty stomach at the beginning of competition

Athletes must also be aware of the kind of food that should be completely avoided during the pre-competition stage. They are:

- high fat foods (fried foods and high fat meats)
- sweet food such as candy, sugar and honey.
- tea, coffee, colas and chocolate
- certain raw fruits and vegetables, dry beans and nuts.
- new and unusual foods

### Nutrition during Competition

All-day events like swimming competitions and athletics where an athlete is expected to perform multiple times throughout the day can be very problematic to the eating schedules. As such, they may need to consume several small meals throughout the day to keep their bodies running effectively without becoming fatigued. Basically, the multiple meals should be small (about 300 calories) and low in fat and should ideally be eaten at least 1 hour prior to each event. These are the types of food which are best consumed in between events in all-day sports competitions:

- low-fat yogurt
- bananas, apples, oranges or any other fruit
- some sports drinks and sports bars, carrot sticks, and cereal bars

### Post –Competition meal

During competition, an athlete uses up nutrients and energy needed to build muscles. Therefore, it is important for the athlete to replenish these stores (glycogen and fluid) after competition. If the glycogen stores are not refueled, they remain low and may cause fatigue faster in the next bout of physical activity.

Similarly fluid levels should also be replenished in order to prevent a decline in performance due to dehydration in subsequent events or competitions. Generally, it is recommended that an athlete consumes up to 1 litre of fluid per 1kg of body weight loss. This should ideally be done within six hours to achieve optimal hydration status.

Sports drinks are excellent substitutes for water and can be consumed in moderation. On the other hand, athletes should completely avoid alcohol, caffeine and other carbonated beverages following competition. These drinks, especially alcohol, can slow down the body recovery by interfering with the refueling of glycogen stores and act as a diuretic that promotes fluid loss. The timing and composition of the post-competition meal depends on the length and intensity of the exercise being performed and after how long the next competition takes place. For instance, it is recommended that the consumption of carbohydrate immediately after exercise is 50-60g followed by 1.5g carbohydrates/kg at 2 hours intervals.

Although it is generally believed that carbohydrate and fat are the only sources of energy during physical activity, recent experimental results suggest that there are also significant alterations in protein metabolism during exercise. Depending on several factors, including intensity, duration and type of exercise, as well as prior diet, training, environment and perhaps even gender or age, these changes may be quite large. Generally, exercise promotes: a decrease in protein synthesis (production)

unless the exercise duration is prolonged (greater than 4h) when increases occur; either an increase or no change in protein catabolism (breakdown); and an increase in amino acid oxidation. In addition, significant sub-cellular damage to skeletal muscle has been shown following exercise. Taken together, these observations suggest that the protein requirements of active individuals are greater than those of inactive individuals. Although the underlying reasons are different, this statement applies to both endurance and strength/power athletes. At present, it is not possible to precisely determine protein requirements. However, because deficiencies in total protein or in specific amino acids may occur, we suggest that athletes consume 1.8 to 2.0 g of protein/kg of bodyweight/day. This is approximately twice the recommended requirement for sedentary individuals. For some athletes this may require supplementation; however, these quantities of protein can be easily obtained in a diet where 12 to 15% of the total energy is from protein. Although the effect of exercise on protein metabolism has been studied for many years, numerous questions remain. Hopefully, with the recent renewed interest in this area of study, most of these answers will soon be available.

### Conclusion

Nutrition is a key component for peak physical performance. Sportspeople must form correct eating habits based on the many different circumstances of their sports career. Concerted attempts should be made to eat healthily, as certain foods contain nutrients that are essential to optimal performance in sporting activities. Proper nutrition can contribute not only to a person's well-being but also ensure success in sports. Although, there is no magic food that will compensate for poor training, it is a widely accepted fact that to have the winning edge, proper nutrition is crucial.

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