In this new millennium, our love affair with fitness and sports continues to grow. More of us participate in physical activities such as football, basketball, bicycling, golf, running, tennis, weight training, and a host of other recreational activities and sports. Improvement in health and fitness is one of the major reasons that more and more people initiate an exercise programme. Research has shown that adults who become physically active also may become more interested in other aspects of their lifestyles – particularly nutrition – that may affect their health in a positive way.

Nutrition is the study of foods and their effects upon health, development, and performance. Although a relatively young science, nutrition research has made a significant contribution to our knowledge of essential nutrient needs. During the first part of the twentieth century, most nutrition research focused on identification of essential nutrients and amounts needed to prevent nutrient – deficiency diseases, such as scurvy from inadequate vitamin C. More recently medical researchers have focused on the effects of foods and their specific constituent as a means to help prevent major chronic diseases, such as heart disease and cancer, that are epidemic in developed countries. Nutriceutical is a relatively new term used to characterize the drug,
or medical, effects of a particular nutrient. Recent research findings continue to indicate that our diet is one of the most important determinants of our health status.

Other than the health benefits of exercise and fitness, many physically active individuals also are finding the joy of athletic competition, participating in local sport event such as golf tournaments, tennis matches, and road races. Individuals who compete athletically are always looking for a means to improve performance, be it a new piece of equipment or an improved training method. In this regard, proper nutrition may be a very important factor in improving exercise and sports performance. Although the effect of diet on exercise performance had been studied only sporadically prior to 1970, subsequently numerous sport scientists and sport nutritionists have studied the effect of nutrition, such as diet composition and dietary supplements, on exercise and sport performance. Results of these studies have provided nutritional guidance to enhance performance in specific athletic endeavors.

What Are Nutrients?

A glass of milk or a spoonful of peanut butter may seem as if it is all one substance, but in reality most foods are made up of many different chemicals. Some of these chemicals are not useful to the body, whereas others
are critical to human growth and function. These latter chemicals are referred to as nutrients. The six groups of nutrients found in the foods we eat are

- Carbohydrates
- Fats and oils (two types of lipids)
- Proteins
- Vitamins
- Water

As you may know, the term *organic* is commonly used to describe foods that are grown without the use of non–natural fertilizers or chemicals. But when scientists describe individual nutrients as *organic*, they mean that these nutrients contain an element called carbon that is an essential component of all living organisms. Minerals and water are *inorganic* because they do not contain carbon. Both organic and inorganic nutrients are equally important for sustaining life but differ in their structures, functions, and basic chemistry.

**Carbohydrates, Fats, and Proteins Are Nutrients That Provide Energy**

Carbohydrates, fats, and proteins are the only nutrients in foods that provide energy. By this we mean that these nutrients break down and reassemble into a fuel that our body uses to support physical activity and basic functioning. Although taking a multivitamin and a glass of water might
be beneficial in other ways, it will not provide you with the energy you need to do your twenty minutes on the stair–climber! The energy nutrients are also referred to as **macronutrients**. *Macro* means “large”, and our bodies need relatively large amounts of these nutrients to support normal function and health.

Alcohol is a chemical found in food, and it provides energy—but it is not considered a nutrient essential for good health. This is because it does not support the regulation of body functions or the repairing of tissues. In fact, alcohol is considered to be both a drug and a toxin.

We express energy in units of *kilocalories* (kcal). Both carbohydrates and Proteins provide 4 kcal per gram, alcohol provides 7 kcal per gram, while fats provide 9 kcal per gram. Thus, for every gram of fat we consume, we obtain more than twice the energy as compared to a gram of carbohydrate or protein.

**Carbohydrates Are a Primary Fuel Source**

Carbohydrates are the primary source of fuel for our bodies, particularly for our brain and during physical exercise. A close look at the word “carbohydrate” reveals the chemical structure of this nutrient. *Carbo* – refers to carbon, and *hydrate* - refers to water. You may remember that water is made up of hydrogen and oxygen. Thus, carbohydrates are composed of chains of carbon, hydrogen, and oxygen.
Carbohydrates encompass a wide variety of foods; rice, wheat, and other grains, as well as vegetables are carbohydrates, and fruits contain natural sugars that are carbohydrates. Carbohydrates are also found in legumes (including lentils, dry beans, and peas), milk and other dairy products, seeds and nuts.

**Fats Provide Energy and Other Essential Nutrients**

**Fats**, a type of lipids, are another important source of energy for our body’s. Lipids are a diverse group of organic substances that are insoluble in water. Lipids include triglycerides (more commonly known as fats), phospholipids, and sterols. Like carbohydrates, fats are comprised of carbon, hydrogen, and oxygen; however, they contain proportionally much less oxygen and water than carbohydrates do. This quality allows them to pack together tightly, which explains why they yield more energy per gram than either carbohydrates or proteins.

Fat is an important energy source for our bodies at rest and during low intensity exercise. Our body is capable of storing large amount of fat as adipose tissue. These fat stores can be broken down for energy during periods of fasting for example, while we are asleep. Foods that contain fats are also important in providing fat-soluble vitamins and essential fatty acids.

Dietary fats come in a variety of forms. Solid fats include such things are butter, lard and margarine. Liquid fats are referred to as oils and include
vegetable oils such as canola and olive oils. Cholesterol is a form of lipid that is synthesized in our bodies, and it can also be consumed in the diet.

**Proteins Support Tissue Growth, Repair, and Maintenance**

Proteins also contain carbon, hydrogen, and oxygen, but they are different from carbohydrates and fats in that they contain the element nitrogen. Within proteins, these four elements assemble into small building blocks known as amino acids. We break down dietary proteins into amino acids and reassemble them to build our own body proteins- for instance, the proteins in our muscle and blood.

Although proteins can provide energy, they are not a primary source of energy for our bodies. Proteins play a major role in building new cells and tissues, maintaining the structure and strength of bone, repairing damaged structures, and assisting in regulating metabolism and fluid balance.

Proteins are found in many foods. Meats and dairy products are our primary sources of proteins, but we also obtain small amounts of proteins from vegetables and whole grains. Seeds, nuts, and legumes are good sources of protein.

**Vitamins assist in the Regulation of Biological Processes**

Vitamins are organic compounds that assist us in regulating our body’s processes. Vitamins are critical in building and maintaining healthy bone and
muscle tissue, supporting our immune system so we can fight illness and
disease, and ensuring healthy vision. They also assist in maintaining the
health of our blood. Contrary to popular belief, vitamins do not contain
energy (or calories); however, vitamins do play an important role in assisting
our bodies with releasing and utilizing the energy found in carbohydrates,
fats, and proteins. Because we need relatively small amounts of these
nutrients to support normal health and body functions, the vitamins (in
addition to minerals) are referred to as micronutrients.

Vitamins are classified as two types: fat-soluble and water soluble.
This classification is based upon their solubility in water, which affects how
vitamins are absorbed, transported, and stored in our bodies. As our bodies
cannot synthesize most vitamins, we must consume them in our diets. Both
types of vitamins are essential for our health and are found in a variety of
foods. Let’s now review the different properties of fat-soluble and water
soluble vitamins.

**Fat Soluble Vitamins Are Stored in the Body**

Vitamins A, D, E and K are fat-soluble vitamins. Fat-soluble vitamins
are absorbed in our intestines along with dietary fat. They are then transported
to the liver or other organs, where they are either utilized or stored for later
use.
Our ability to store fat-soluble vitamins sets them apart from the water-soluble vitamins. Because we are capable of storing them vitamins, we do not have to consume the recommended intakes of these nutrients on a daily or weekly basis. As long as our diet contains the average amounts recommended over a given time period, intakes of these vitamins will be sufficient to support healthy function.

Storing fat-soluble vitamins can have its disadvantages. Consuming large amounts of these vitamins, particularly from supplements, can cause an excessive build–up and lead to dangerously toxic levels. Toxicity can occur relatively quickly for some of these vitamins. Toxicity symptoms include damage to our hair, skin, bone, eyes, and nervous system.

Even though we can store fat-soluble vitamins, deficiencies can add to occur, although they are relatively uncommon. Eating too little fat in our diet or excreting these vitamins from our digestive tract along with undigested fat can lead to deficiencies. Using mineral oil as a laxative can result in a significant loss of fat-soluble vitamins in our feces. Diets that are extremely low in fat, as well as diseases that prevent the normal absorption of fat can also result in fat-soluble vitamin deficiencies. Deficiencies of fat-soluble vitamins can lead to serious health problems such as night blindness and osteoporosis and even death in the most severe cases.
Fat-soluble vitamins are found in a variety of fat-containing foods. Meats, dairy products, vegetable oils, avocados, nuts, and seeds are all potentially good sources.

**Water Soluble Vitamins Should be Consumed Daily or Weekly**

In contrast to the fat-soluble vitamins, water-soluble vitamins dissolve in water. Vitamin C and B vitamins (thiamin, riboflavin, niacin, vitamin $B_6$, vitamin $B_{12}$, pantothenic acid, biotin, and folate) are absorbed through the intestinal wall directly into the bloodstream. These vitamins then travel to the cells of the body where they are needed.

Precisely because these vitamins dissolve in water, we cannot store large amounts of them. Our kidneys filter out any excess water-soluble vitamins we consume, and we then excrete this excess in our urine. Because we cannot store large amount of these vitamins, toxicity rarely occurs when we consume excess amounts in our diet. We can consume toxic levels of these nutrients through supplementation, however, if we consume higher amounts than our bodies can eliminate.

Another consequence of our inability to store large amounts of water-soluble vitamins is that we need to consume adequate amounts of these nutrients on a daily or weekly basis. If we do not regularly consume these nutrients in our diets, deficiency symptoms and even disease can result fairly quickly. However, this does not mean that we must take vitamin supplements
to obtain adequate amounts of these nutrients. The water-soluble vitamins are abundant in many foods, including whole grains, fruits, vegetables, meat, and dairy products.

**Minerals Assist in the Regulation of Many Body Functions**

Minerals are in organic substances, meaning that they do not contain carbon. Some important dietary minerals include sodium, potassium, calcium, magnesium, and iron. Minerals are different from the macronutrients and vitamins in that they are not broken down during digestion or when our bodies use them to promote normal function; they are also not destroyed by heat or light. Thus, all minerals maintain their structure no matter what environment they are in. This means that the calcium in our bones is the same as the calcium in the milk we drink, and the sodium in our cells is the same as the sodium in our table salt.

Minerals have many important functions in our bodies. They assist in fluid regulation and energy production, are essential to the health of our bones and blood, and help rid our body of harmful by-products of metabolism.

Minerals are classified according to the amounts we need in our diet and according to how much of the mineral is found in our bodies. The two categories of minerals in our diets and bodies are the major minerals and the trace minerals.
**Water supports all body functions**

Water is an inorganic nutrient that is vital for our survival. We consume water in its pure form, in juices, soups, and other liquids, and in solid foods such as fruits and vegetables. Adequate water intake ensures the proper balance of fluid both inside and outside of our cells, and also assists in the regulation of nerve impulses, muscle contractions, nutrient transport, and excretion of waste products. Because of the key role that water plays in our health.

**Nutrition and Health – Related Fitness**

Nutrition usually is defined as the sum total of the process involved in the intake and utilization of food substances by living organisms, including ingestion, digestion, absorption, transport and metabolism of nutrients found in food. This definition stress the biochemical or physiological functions of the food we eat, but the American Dietetic Association notes that nutrition may be interpreted in broader sense and be affected by a variety of psychological, sociological, and economic factors.

Although our food selection may be influenced by these latter factors, particularly economic ones in the case of many college students, the biochemical and physiological roles of many different types of food are similar. From a standpoint of health and sport performance, it is the biochemical and physiological role or function of food that is important.
The primary purpose of the food we eat is to provide us with a variety of nutrients. A nutrient is a specific substance found in food that performs one or more physiological or biochemical functions in the body. There are six major classes of nutrients found in food: carbohydrates, fats, proteins, vitamins, minerals, and water. However, food contains substances other than essential nutrients that may affect body functions.

The major nutrients perform three basic functions. First, they provide energy for human metabolism. Carbohydrates and fats are the prime sources of energy. Protein may also provide energy, but this is not its major function. Vitamins, minerals, and water are not energy sources. Second, nutrients are used to promote growth and development by building and repairing body tissue. Protein is the major building material for muscle, other soft tissues, and enzymes, while certain minerals such as calcium and phosphorous make up the skeletal framework. Third, nutrients are used to help regulate metabolism, or body process. Vitamins, minerals, and proteins work closely together to maintain the diverse physiological processes of human metabolism. For example, hemoglobin in the red blood cell (RBC) is essential for the transport of oxygen to muscle tissue via the blood. Hemoglobin is a complex combination of protein and iron, but other minerals and vitamins are needed for its synthesis and for full development of the RBC.
In order for our bodies to function effectively, we need more than forty specific essential nutrients, and we need these nutrients in various amounts as recommended by nutrition scientists.

**Role of nutrition in health promotion**

Let food be our medicine and medicine be your food. This statement has been attributed to Hippocrates for over two thousand years, and it is becoming increasingly meaningful as the preventative and therapeutic health values of food relative to the development of chronic diseases are being unraveled. As noted previously, nutrients and other substances in foods may influence gene expression, some having positive and others negative effects on our health.

Most chronic diseases have a genetic basis: if one of your parents has had coronary heart disease or cancer, you have an increased probability of contracting that disease. Such diseases may go through three stages: initiation, promotion, and progression. Your genetic predisposition may lead to the initiation stage of the diseases, but factors in your environment promote its development and eventual progression. In this regard, some nutrients are believed to be promoters that lead to the progression of the disease, while other nutrients are believed to the antipromoters that deter the initiation process from progressing to a serious health problem.
Health benefits when both exercise and diet habits are improved

Most chronic diseases are caused by the interaction of many factors, including genetic factors and multiple independent lifestyle behaviors. To decrease our risk of developing any given disease, we should attempt to reduce as many risk factors as possible that are associated with the development of that disease. Recent surveys among college students have shown that when individuals initiate an exercise program, they are also more likely to begin to modify their diet, eating more healthful foods, such as less fat and more fruits, vegetables, and fiber.

In several recent articles, Steven Blair and his associates have noted that although numerous studies have demonstrated the beneficial effects of nutrition and physical activity separately to help reduce various risk factors associated with chronic disease, fewer studies have been conducted to evaluate the synergistic effects of exercise and diet to promote health.

Nevertheless, although both proper exercise and sound nutrition habits may confer health benefits separately, the reduction in the sum total of risk factors would appear to be maximized when both exercise and nutrition are part of a healthy lifestyle. The risk factors for health disease, the key lifestyle behaviors that may effective in favorably modifying heart disease risk factors are proper nutrition and exercise. Moreover, several of the risk factors for heart disease are diseases themselves, such as diabetes, obesity, and high
blood pressure, all of which may benefit from the combination of proper nutrition and exercise. A combination diet exercise regimen is the favored approach for prevention and treatment of obesity, a disease unto itself and a major risk factor for other chronic diseases.

**Nutrition, Exercise, and Sports-Related Fitness**

As with health, genetic endowment plays an important underlying role in the development of success in sport, but so too do lifestyle behavior, such as appropriate sports training and sports nutrition.

One of the key factors determining success in sports is the ability to maximize your genetic potential with appropriate physical and mental training to prepare both mind and body for intense competition. In this regard, athletes develop sports related fitness, that is, fitness components such as strength, power, speed, endurance, and neuromuscular motor skills specific to their sport.

Training of elite athletes at the United States Olympic Training Center (USOTC) focuses on three attributes: Physical power, mental strength, and mechanical edge. Coaches and scientists work with athletes to maximize physical power production for their specific sport, to optimize mental strength in accordance with the psychological demands of the sport, and to provide the best mechanical edge by improving specific fitness and sport skills, sportswear, and sports equipment. Jay Kearney, former senior sport scientist
at the USOTC, has noted that sports science and technology provide elite competitors with the tiny margins needed to win in world-class competition.

Athletes at all levels of competition, whether an elite international competitor, a college wrestler, a high school baseball player, a seniors age group distance runner, or a youth league soccer player, can best improve their performance by intense training appropriate for their age, physical and mental development, and sport. As the saying goes, “Do the best with what you got”. However, sports and exercise scientists have investigated a number of means to improve athletic performance beyond that attributable to training, and one of the most extensively investigated areas has been the effect of nutrition.

**Sports nutrition**

The state-of-the-art physical and mental training is one of the most important factors underlying success in sports. At high level of athletic competition, athletes generally receive excellent coaching to enhance their biomechanical skills (mechanical edge), sharpen their psychological focus (mental strength), and maximize physiological functions (physical power) essential for optimal performance. Clyde Williams, a renowned sport scientist from England, notes that in addition to specialized training, from earliest times certain foods were regarded as essential preparation for physical activity, Whether this was for confrontation on the battlefields of history or
competition in the stadiums of ancient Greece, the aim being to achieve greater strength, power, and stamina than one’s opponent.

As we see there are various dietary factors that may influence biomechanical, psychological, and physiological consideration in sport. For example, losing excess body fat will enhance biomechanical efficiency: consuming carbohydrates during exercise may maintain normal blood sugar levels and prevent psychological fatigue: and providing adequate dietary iron may ensure optimal oxygen delivery to the muscles. All these sports nutrition factors may impact favorably upon athletic performance.

Sports nutrition is a relatively new area of study involving the application of nutritional principles to enhance sports performance. Louise Burke, a prominent sports nutritionist from Australia, defines sports nutrition as the application of eating strategies to promote good health and adaptation to training, to recover quickly after each exercise training session, and to perform optimally during competitions. Although investigators have studied the interaction between nutrition and various forms of sport or exercise for more than a hundred years, it is only within the past few decades that extensive research has been undertaken regarding specific recommendations to athletes.

Several factors suggest that sports nutrition is becoming increasingly important for optimal athletic performance, and is a viable career opportunity.
Are athletes today receiving adequate nutrition?

The dietary habits of athletes may vary tremendously, particularly when different sports are compared. Surveys conducted with several different groups of athletes reveal that some athletes may be obtaining an adequate intake of nutrients while others may not. An excellent review is presented by Sarath Short of Syracuse University who provides a critique of the validity and usefulness of various survey techniques used to assess average nutrient intake. The usual method in these studies was to obtain a three-to-seven-day record of the food intake of the athletes and then use computer analyses to compare their intake with the RDA for a variety of nutrients. Although not all studies are in agreement, certain athletic groups, such as football players and strength athletes, appear to obtain adequate nutrition, while inadequate nutrient intakes have been reported in other athletic groups, including ballet dancers, basketball players, bodybuilders, gymnasts, runners, skiers, swimmers, triathletes, and wrestlers.

Inadequate nutrient intakes have been reported for athletes of both genders and all age levels, ranging in athletic ability from the high school level to Olympic caliber. Athletes involved in weight control sports, such as dancers, gymnasts, bodybuilders, distance runners, and wrestlers are most susceptible to poor nutrient intake. Female athletes were much more likely than males to incur inadequate nutrient intake. The most significant dietary
deficiency in most studies was iron, although zinc, calcium, protein and several of the B vitamins also were found to be inadequate by several investigators. In many of these studies, including a nationwide survey of elite athletes, inadequate nutrient intake was due to a very low caloric intake. In addition, several studies have revealed a high incidence of eating disorders in these groups of athletes as they adopted bizarre techniques in attempts to control body weight. Although this problem is more prevalent in females, a small percentage of male athletes also exhibit disordered eating behaviors.

Compared with the recommendations of sports nutritionists, many endurance athletes consume a diet which may be considered deficient in carbohydrates. Although Hawley and others indicate that such diets have not been shown to impair athletic performance, they suggest that an increased carbohydrate intake would probably improve an athlete’s training capacity, especially when rapid recovery between intense exercise bouts is required. Theoretically, this enhanced training would lead to improved performance in competition.

This brief review indicates that some athletic groups are not receiving the recommended allowances for a variety of essential nutrients or may not be meeting certain recommended standards. It should be noted, however, that these surveys have analyzed the diets of the athletes only in reference to a standard, such as the RDA, and many studies have not analyzed the actual
nutrient or biochemical status (such as by a blood test) of the athlete or the effects that the dietary deficiency exerted on exercise performance capacity or sport performance. The RDA for vitamins and minerals incorporates a safety factor, so an individual with a dietary intake of essential nutrients below the RDA may not necessarily suffer a true nutrient deficiency. On the other hand, if the athlete does develop a nutrient deficiency, then athletic performance may deteriorate, and some deficiencies may lead to injuries.

For a number of reasons, many athletes do not appear to be getting adequate nutrition. In a recent report, several international sports nutrition experts indicated that although athletes may be making conscious efforts to eat an appropriate diet, they may be confused about the nutrient content of the foods they eat. These feelings have been reinforced by Short in her extensive review and by other subsequent studies that have shown that the nutritional knowledge of athletes is relatively poor, hence, the athlete may not have the basis to select and prepare nutritious meals. Other constraints, such as finances and time, may limit food selection and preparation.

Moreover, athletes may not be receiving sound nutritional information from their coaches. Several surveys cited by Short, and a recent survey of wrestling coaches, revealed that many coaches at the high school and college levels have poor backgrounds in nutrition, with approximately 60 to 80 percent of the coaches noting that they had not had a formal course in
nutrition or were in need of a better background. However, this situation appears to be changing as many coaches and athletic trainers are taking college-level courses in nutrition, some courses specifically in sports nutrition. The national Athletic Trainers Association requires a course in nutrition for certification.

**How important is nutrition to athletic performance?**

As mentioned previously, the ability to perform well in an athletic event is dependent primarily upon two factors: genetic endowment and state of training. First and foremost is genetic endowment. The individual athlete must possess the characteristics that are necessary for success in his or her chosen sport. For example, a world-class male marathoner must have a high aerobic capacity and a low body fat percentage in order to run over 26 sub-five-minute miles. However, unless he has undergone a strenuous training program and maximized his genetic potential, his performance will be suboptimal. The state of training is the most important factor differentiating athletes of comparable genetic endowment. The better trained athlete has the advantage. No matter or what level the athlete is competing, be it a world championship or a high school swimming meet, genetic endowment and state of training are the two most critical factors determining success. Nevertheless, the nutritional status of the athlete may also exert a significant impact upon athletic performance. An internationally renowned Olympic sports medicine
Introduction

physician, L. Prokop, has noted that again and again he has seen a minor, seemingly negligible mistake in the diet ruin many months and years of hard training at the critical moment.

Malnutrition represents unbalanced nutrition and may exist as either under nutrition or over nutrition, that is, an individual does not receive an adequate intake (under nutrition) or consumes excessive amounts of single or multiple nutrients (over nutrition). Either condition can hamper athletic performance. As noted previously, the three major functions of foods are to supply energy, regulate metabolism, and build and repair body tissue. Thus an inadequate intake of certain nutrients may impair athletic performance due to an insufficient energy supply, an inability to regulate exercise metabolism at an optimal level, or a decreased synthesis of key body tissue or enzymes. On the other hand, excessive intake of some nutrients may also impair athletic performance, and even the health of the athlete, by disrupting normal physiological processes or leading to undesirable changes in body composition.

Sports nutrition for the physically active person may be viewed from two aspects: nutrition for competition and nutrition for training. Of the three basic purposes of food, to provide energy, to regulate metabolic processes, and to support growth and development— the first two are of prime importance
during athletic competition, while all three need to be considered during the training period in preparation for competition.

**Nutrition for competition** In competition an athlete will utilize specific body energy sources and systems, depending upon the intensity and duration of the exercise. However high energy compounds stored in the muscle are utilized during very short, high intensity exercise: carbohydrate stored in the muscle as glycogen may be used without oxygen for intense exercise lasting about 1 to 3 minutes; and the oxidation of glycogen and fats becomes increasingly important in endurance activities lasting longer than 5 minutes. The release of energy in each of these three systems may require certain vitamins and minerals for optimal efficiency.

If an individual is well nourished, athletic competition normally will not impose any special demands for any of the six major classes of nutrients. But energy stores of carbohydrates and fats are adequate to satisfy the energy demands of most activities lasting less than 1 hour. Protein is not generally considered a significant energy source during exercise. The vitamin and mineral content of the body will be sufficient to help regulate the increased levels of metabolic activity, and body water supply will be adequate under normal environment conditions.

However certain dietary modification may enhance performance when used prior to or during competition. For example, on the basis of the available
research evidence, carbohydrate intake prior to and during exercise bouts of long duration at moderate to high intensity and adequate fluid intake prior to and during similar endurance events conducted in warm or hot environmental conditions are two dietary practices that have consistently been shown to increase performance capacity.

Although not all research findings are in agreement, a number of well-designed studies with several other nutrients or related compounds have documented beneficial effects upon laboratory and field exercise tasks. Some of these tasks are comparable to competitive athletic events. With some of the compounds, such as sodium bicarbonate, the scientific evidence supportive of a beneficial effect is somewhat strong whereas with others, such as sodium phosphate, the data are less conclusive.

**Nutrition for training:** Proper nutrition during training is one of the keys to success in competition. Because energy expenditure increases during a training period, the caloric intake needed to maintain body weight may increase considerably— an additional 500-1,000 Calories or more per day in certain activities. By selecting these additional Calories wisely from a wide variety of foods, you should obtain an adequate amount of all nutrients essential for the formation of new body tissues and proper functioning of the energy systems that work harder during exercise. A balanced intake of carbohydrate, fat, protein, vitamins, minerals, and water is all that is
necessary. For endurance athletes, dietary carbohydrates should receive even greater emphasis.

However, there may be some circumstances during sport training that particular attention to the diet is important. For example, during the early phases of training the body will begin to make adjustments in the energy systems so that they become more efficient. This is the so-called chronic-training effect, and many of the body’s adjustments incorporate specific nutrients. For example, one of the chronic effects of long distance running is an increased hemoglobin content in the blood and increased myoglobin and cytochromes in the muscle cells; all three compounds need iron in order to be formed. Hence, the daily diet would need to contain adequate amounts of iron not only to meet normal needs but also to make effective body adjustments due to the chronic effects of training.

Based on the available scientific data, nutrient supplementation does not appear to be necessary for the well nourished athlete during training. However, there are a number of viable theories suggesting some nutrients may be helpful under certain circumstances. For example, excessive exercise training may lead to chronic fatigue in athletes, often referred to as the overtraining syndrome, characterized by suboptimal performance. Although the etiology of the overtraining syndrome is unknown, several theories postulate adverse changes in the skeletal muscle or the immune system.
Derman and others suggest that skeletal muscle disorders may be involved in the athlete presenting with chronic fatigue. Nutritionally, vitamin E supplementation has been studied as a possible means to help prevent muscle tissue damage. Shephard and Shek note that a nutritional imbalance can adversely affect immune function of competitive athletes, particularly already thin athletes who may adopt an unusual diet to lose more body mass in an attempt to enhance performance. Supplementation with various amino acids, particularly glutamine, has been studied as a means to strengthen the immune system. Although the underlying theory may be viable with these and other nutrients, the research data are usually limited or controversial and additional research is needed.

Nutrient supplementation may be warranted in some cases. For example, in activities where excess bodyweight may serve to handicap performance, a loss of some body fat may be helpful. Although the use of a very low-Caloric diet to achieve a desirable competitive weight is not advised, vitamin-mineral supplements may be recommended to prevent a nutrient deficiency in athletes who use such a procedure.

**What should an athlete eat to help optimize his athletic performance?**

The importance of nutrition to your athletic performance may depend on a variety of factors, including your gender, your age, your body weight status, your eating and lifestyle patterns, the environment, the type of training
you do, and the type of sport or event in which you participate. As an example of the latter point, the nutrient needs of a golfer or baseball player may vary little from those of the nonathletic, whereas those of a marathon runner or ultra endurance triathlete may be altered significantly during training and competition.

The opinions offered by researchers in the area of exercise and nutrition relative to optimal nutrition for the athlete run the gamut. At one end, certain investigators note that the daily food requirement of athletes is quite similar to the nutritionally balanced diet for everyone else, and therefore no special recommendation are needed. On the other extreme, some state that it is almost impossible to obtain all the nutrients the athlete requires from the normal daily intake of food, and for that reason nutrient supplementation is absolutely necessary. Other reviewers advocate a compromise between these two extremes, recognizing the importance of a nutritionally balanced diet but also stressing the importance of increased consumption of specific nutrients or dietary supplements for athletes under certain situation.

In general, athletes who consume enough Calories to meet their energy needs and who meet the requirements for essential nutrients should be obtaining adequate nutrition. The key to sound nutrition for the athletic individual is to eat wide variety of healthful foods.
The need for sound nutrition is especially important for all females and for young males who engage in strenuous physical training. Females need to pay special attention to the iron and calcium content of their diet because of possible health problems. During the growth and development years of childhood and adolescence, the need for protein, calcium, and iron, as well as many other nutrients, is relatively high because the muscle, bone, and other body tissues are growing rapidly. Strenuous exercise may increase these needs slightly, but obtaining adequate caloric intake from healthful foods should easily provide the nutrients needed. A nutritionally balanced diet is still the keystone of sports nutrition, but some athletes may benefit from dietary modifications.

**When and what should an athlete eat prior to competition**

Dietary practices such as carbohydrate loading and substantial intake of carbohydrates in the pre-event meal are designed to maximize body stores of muscle liver glycogen. Although most athletic events are not longed endurance events, there may be some import points to consider regarding the timing and composition the meal eaten prior to competition.

It is a well-established fact that the ingestion of food just prior to competition will not benefit physical performance in most athletic events, yet the pregame meal so to speak, is one of the major topics of discussion among athletes. A number of special meals have been utilized throughout the years
because of their alleged benefits to physical performance, and special products have been marketed as pre-event nutritional supplements. Although research has not substantiated the value of any one particular precompetition meal, some general guidelines have been developed from practical experience over the years.

There are several major goals of the precompetition meal that may be achieved through proper timing and composition. In general, the precompetition meal should do the following.

1. Allow for the stomach to be relatively empty at the start of competition.
2. Help to prevent or minimize gastrointestinal distress.
3. Help avoid sensations of hunger, lightheadedness or fatigue.
4. Provide adequate fuel supplies, primarily carbohydrate, in the blood and muscles.
5. Provide an adequate amount of body water.

In general, a solid meal should be eaten about 3 to 4 hour prior to competition. This should allow ample time for digestion to occur so that the stomach is relatively empty, and yet hunger sensations are minimized. However, prevent emotional tension or anxiety may delay digestive time, as will a meal with a high-fat or high-protein content. Hence, the composition of
The meal is critical. It should be high in carbohydrate, low in fat, and low to moderate in protein, providing for easy digestibility.

The composition of the precompetition meal should not contribute to any gastrointestinal distress, such as flatulence, increased acidity in the stomach, heartburn, or increased bulk that may stimulate the need for a bowel movement during competition. In general, foods to be avoided include gas formers like beans, spicy foods that may elicit heartburn, and bulk foods like bran products. High sugar compounds may delay gastric emptying or create a reverse osmotic effect, possibly increasing the fluid content of the stomach, which may lead to a feeling of distress, cramps, or nausea. High sugar loads, particularly fructose, may also lead to other forms of gastrointestinal distress, such as diarrhea. Large amount of concentrated sugar can cause a reactive drop in blood sugar in susceptible individuals. Individuals with known food intolerances, such as lactose intolerance, should use due caution. Through experience, you should learn what foods disagree with you during performance, and of course, you should avoid these prior to competition.

Adequate fluid intake should be assured prior to an event, particularly if the event will be of long duration of conducted under hot environmental conditions. Diuretics such as alcohol, which increase the excretion of body water, should be avoided. Large amount of protein increase the water output
of the kidneys and thus should be avoided. Fluids may be taken up to 15 to 30 minutes prior to competition to help ensure adequate hydration.

A wide variety of foods may be selected for the precompetition meal. The meal should consist of foods that are high in complex carbohydrate with moderate to low amounts of protein. The foods should be agreeable to you. You should eat what you like within the guidelines presented above.

**What should an athlete eat during competition?**

There is no need to consume anything during most types of athletic competition with the possible exception of carbohydrate and water. Carbohydrate may provide additional supplies of the preferred energy source during prolonged exercise, while water intake may be critical for regulation of body temperature when exercising in warm environments. In very rare cases, such as ultradistance competition, a hypotonic salt solution may be recommended.

**What should an athlete eat after competition or a hard training session?**

In general, a balanced diet is all that is necessary to meet your nutrient needs and restore your nutritional status to normal following competition or daily, hard physical training. Carbohydrate and fat are the main nutrients used during exercise and can be replaced easily from foods among the food exchange lists. The increased caloric intake that is needed to replace your
energy expenditure also will help provide you with the additional small amounts of protein, vitamins, minerals, and electrolytes that may be necessary for effective recovery. Thirst will normally help replace water losses on a day-to-day basis; you can check this by recording your body weight each morning to see if it is back to normal.

Those individuals involved in daily physical activity of a prolonged nature, such as long-distance running and swimming or prolonged tennis bouts, should stress complex carbohydrate foods in their daily diet. This will help replenish muscle glycogen, which is necessary for continued daily workouts at high intensity. Complex carbohydrates are also rich in the vitamins and minerals necessary for their metabolism in the body. Simple sugars eaten immediately after a hard workout may help restore muscle glycogen fairly rapidly, but the addition of protein to the carbohydrate source may be even more effective.

For those who must compete several times daily and eat between competitions, such as in tennis tournaments or swim meets, the principles relative to pregame meals may be relevant.

**Conclusion**

Over the past 10-15 years, knowledge of the relationship between nutrition and sports has grown dramatically. Great strides have been made as to the ergogenic effects and health benefits to certain dietary practices.
Despite this knowledge, efforts to effectively and systematically promote positive dietary practices among the majority of athletes, for both performance and health reasons, has lagged behind.

Although nutritionists have developed numerous educational resources for athletes, coaches, parents and administrators, there is no a specific model or framework upon which to base decision when developing and implementing nutrition education programs. In addition, little research has been conducted to explore the psycho-socio-cultural aspects of nutrition and sports. There is a lack of understanding about influences that affect the athlete from inside and outside the sporting world as it relates to food.

To further explore the relationship between nutrition and sport, a practical model need to be developed to provide a framework for understanding influences that affect athletes food choices: educating coaches and athletes about healthful nutrition and dietary practices: implementing group nutrition education programs and individual counseling for athletes: and questioning our understanding of what influences athletes knowledge and food selection.

Coaches, trainers, and physical education teachers provide nutrition education for athletes and even dispense nutrition supplements with little, or no, knowledge of sports nutrition. Williams states that “the education of modern coaches should include nutrition among other subjects……” He
indicates that without valid information, myths and misconceptions will continue. Athletes often cite coaches as a major source of nutrition information. Coaches, trainers, and especially athletes need more effective nutrition education. Not only do they need to know more about diet for fitness and sports, but they need to be warned about buying useless or even dangerous pills and other products. Very few athletes realize that fad products sold as food supplements are not monitored for efficacy or safety. Athletes should be warned about nutrition information presented by unqualified people attempting merely to sell a product. More emphasis is needed on scientifically based nutrition education.

Nutrition adequacy is not going to make an Olympian from someone who has not trained, but good nutrition is an essential part of all athletes training. Elite teams have physician, coaches, trainers, strength coaches, and sports psychologist yet ignore the nutritional practices used by athletes. All health professional, including qualified sports nutritionists, must work together for the good of each individual athlete.

Statement of the Problem

The purpose of the study was to assess the Nutritional knowledge of Athletes, Coaches and College Teachers of Physical Education in Kerala.
Delimitations

1. The study was delimited to Men and Women Athletes of Track and field, Volleyball, Football, Basketball and Handball who have represented their respective universities.

2. The coaches attached to the Kerala Sports Council and Sports Authority of India in Kerala state only were selected for the purpose of the study.

3. The teachers for the study was delimited to Physical Education teachers who are working in the colleges under Kannur University, Calicut University, Mahatma Gandhi University and Kerala University.

Limitation

1. Questionnaire research may have limitations. As such any bias that might have crept in to the response in this account may be considered as limitation of the study.

2. No motivational factors were used during the collection of data.

Hypothesis

Nutritional knowledge is an essential factor for better sports performance. Hence coaches, physical education teachers and outstanding sports persons should have required nutritional knowledge.
Definition and explanations of the terms

Nutrition

Nutrition is defined as the sum total of the processes involved in the intake and utilization of food substances by living organisms including ingestion, digestion, absorption, transport and metabolism of nutrients found in food.

Nutritional Knowledge

It is the knowledge of foods and nutrients and their effect on health, growth and development of the individual.

Athletes

Persons who are participating in any competitive sports events.

Coaches

Persons responsible for guidance, development, preparation and motivation of an athlete.

Significance of the Study

Eating well can have a significant positive impact on athletic performance, and conversely, eating poorly will hinder an athlete’s achievement. In order to maximize potential, an athlete must practice good nutritional habits consistently while preparing for an event. Giving the body
what it needs to refuel and re-energize is just as critical as the training itself. Everything humans consumes has a use, but it is difficult to find the right level at which to consume each category of food; as well as which food will provide high amount of valuable nutrients while minimizing less useful one’s.

In order to best serve athletes, it is necessary to know something about what coaches and physical education teachers telling to players, what athletes know about nutrition and what athletes are actually eating. Coaches, trainers and physical education teachers provide nutrition education for athletes. Athletes often cite coaches and physical education teacher as a major source of nutrition information. Hence coaches, trainers, physical education teachers, and especially athletes need more effective nutrition education.

Survey of nutrition knowledge provide the starting point for nutrition education of athletes, coaches, physical education teachers and other professionals carrying for athletes. It is therefore important to investigate the nutrition knowledge of coaches, physical education teachers and others who influence athletes, since they can greatly affect all aspects of athletes life including their eating habits. The study will bring in to light the misconception regarding nutrition and sports performance at present and also may provide guideline for nutritional education to sports persons and sports professionals.