Nutrition and Hydration Guidelines for Excellence in Sports Performance

International Life Sciences Institute-India

National Institute of Nutrition

Sports Authority of India

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Foreword

training to improve performance in sports. While this is undoubtedly necessary, it is now increasingly realized that nutrition is also critically important. To bring out his message forcefully ILSI-India had organized a Conference on 'Nutrition and Hydration for Excellence in Sports Performance' on 2nd December 2005 in Bangalore. One of the recommendations of the Conference was to set up a Working Group to develop Guidelines on Nutrition and Hydration for Athletes.

Accordingly, a Working Group was constituted with representatives from ILSI-India and National Institute of Nutrition (NIN). The Group visited NIS at Patiala and had extensive discussions with sports scientists, coaches and athletes and also reviewed the institutional arrangements. Discussions were held in Delhi as well at the headquarters of Sports Authority of India (SAI).

Since 1983 NIN had been advising SAI on sports nutrition and had recommended menus for different sports categories. It is observed however that the diets actually consumed by the athletes at different centres did not conform to the nutritional prescriptions.

While the calorie requirements varied with the sports categories it is now found that in the same category of sports energy expenditure at different stages of training varied a good deal. For instance, energy expenditure is lower in transition phase than in pre-competition phase and lower in pre-competition phase than in competition phase. These variations have to be reflected in energy intake to prevent undesired weight gain. Similarly, a uniform training schedule for athletes leads to variations in training load received by the athletes due to weight differences. Hence diets and training schedules have to be designed separately for each athlete and their records maintained for effective monitoring.

Hydration is as critical as nutrition. Sports performance will be seriously affected if fluid balance is disturbed. Research demonstrates that exercise in hot adverse conditions can cause dehydration in less than 15 minutes. Athletes should therefore consume fluids adequately and in time to maintain the fluid balance in the body.

It is finally the athlete himself who has to regulate his nutrition and hydration. Therefore educating the athlete is extremely important. Unfortunately, there are many food fads among both the athletes and the coaches. These need to be replaced by science based concepts about good nutrition and hydration.

The Group has benefited immensely from the research work undertaken by Dr. Venkataramana at the NIN. He prepared the first paper for discussion by the Group at the meetings in Patiala and Delhi. I would like to express my deep appreciation for his valuable contribution.

I would also like to express my gratitude to Dr. Ann Grandjean, Dr. Satynarayana for his pertinent and incisive inputs. Informally the Group received suggestions from Dr. G. L. Khanna, Dr. Rekha Sharma and Dr. Suzie Harris to whom I am greatly indebted. Ms. Rekha Sinha did all the background work with utmost efficiency which was greatly commended.

I am grateful to Mr. R. P. Watal, Director General, SAI for the encouragement and support for the Group. It is our sincere desire that the Report will receive careful attention of SAI, the coaches and athletes participating in national and international events and that the scientifically evolved nutrition and hydration norms will be implemented and followed to improve sports performance.

D. H. Pai Panandiker
Chairman, ILSI-INDIA
Date: March 16, 2007

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I
Introduction

1.1 Nutrition is the study of foods and nutrients and their effect on health, growth, and development of the individual. Sports Nutrition applies nutrition principles to sport with the intent of maximizing performance.

1.2 Success in sports depends on three factors - genetic endowments, the state of training and nutrition. Genetic make-up cannot be changed. Specialized exercise training is the major means to improve athletic performance and proper nutrition is an important component of the total training program. Athletes and Fitness Enthusiasts need the same essential nutrients that non-active people need with varied increases in their caloric needs as well as some increase in macro and micronutrients. Therefore, it is essential to explore and assess these increased nutritional needs of athletes before, during, and after competition for achieving optimal sports performance.

1.3 Health related fitness activities generally include cardiovascular training (aerobic activities such as jogging, swimming, cycling, and hiking), flexibility (stretching), strength (heavy resistance training), muscular endurance (extended resistance to a particular muscle), and appropriate body composition (as opposed to a general scale measurement of total weight). For example, one may set a goal to lose body fat (health-related fitness or event specific goal) and to achieve that goal, he or she would create a regular exercise program that includes all of the above components in addition to choosing more nutrient dense foods in the diet that would support increased demand from activities.

1.4 Sports-related fitness involves skills that are necessary for sports performance. These skills are sport-specific neuromuscular motor skills such as agility, timing and accuracy, balance, speed, strength, power, and endurance. Specificity of training involves training these components as well as the health components that will be directly needed for one's sport.

II
General Nutritional Concepts

2.1 Athlete's nutritional status can be assessed by the ABCDE method that is generally being used for population studies. **A**nthropometrics includes measurements such as weight and height. **B**iochemical analysis include blood and urine tests. **C**linical assessment includes recognizing signs and symptoms of deficiencies or excesses. **D**iet history is a method of assessment that looks at what a person has been eating over a period of time. **E**conomic status is an additional factor that should also be taken into consideration when assessing one's nutritional intake.

2.2 For achieving quality health (desirable body weight and composition specific to the event) and peak performance, it is essential to focus on the task of how an active person or athlete would go about learning what and how much to eat. First, it is important to learn body's nutrient needs; second, categorize those needs and learn the foods to meet those needs; third learn how to think critically about food choices, read labels, and evaluate foods. With these scientific inputs the athlete is ready to create a personalized food plan. Also when athletes travel to participate in international events, they should be given enough information about the kind of food that will be available and how selection has to be made by them. This information is vital because a sudden change in food can affect performance. For this reason athletes must get used to the food that will be served during international events at least for three days before the event. In this direction, the athletes need to be educated.

2.3 There are about 45 essential nutrients that need to be obtained either from the diet or supplements. Those nutrients include glucose, 2 essential fatty acids, 9 essential amino acids, 13 vitamins, about 21 minerals, and water. The simple classification categories are carbohydrates, fats (lipids), protein, vitamins, minerals, and water. All of these are essential for every cell in the body and for human life to exist.

2.4 The nutrients in foods offer four general functions: energy for every cell in the body, growth and repair of tissue, regulation of metabolism, and provision of water for every cell.

2.5 A Calorie in Nutrition is a measurement of energy. It is the amount of heat required to raise the temperature of 1 gram of water by 1 degree celsius. Food is measured in **kilocalories (kcal).** "Calories" with a capital "C" on nutrition label are in kcal.

2.6 There are 3 energy nutrients that provide calories to fuel the cells. Carbohydrates provide 4 kcal per gram and can be generally classified as "complex" or "simple". Physically active people and athletes should consume a majority (65-75%) of their calories from carbohydrates. Lipids (fat) provide 9 kcal per gram and can be generally classified as unsaturated or saturated when considering the fatty acid make-up of triglycerides. It is generally recommended to consume less that 30% of calories from lipids Proteins give 4 kcal per gram and will be approximately 10-15% of one's total calorie needs, if the appropriate grams for amount of calories are chosen. A fourth contributor to energy is alcohol that provides 7 kcal per gram, but can impair athletic performance.

2.7 Organic fat and water-soluble vitamins and inorganic trace and major minerals do not contribute to energy, but they facilitate in the vital metabolic functioning responsible for energy release in the body.

2.8 Water is the sixth category of nutrient and vital to the life of every cell in the body. It is a solvent, lubricant, medium for transport, and temperature regulator that makes up the majority (about 2/3) of our body and yields no energy.

2.9 Protein, carbohydrate, and many vitamin and mineral needs may be increased for physically active people, but these should be easily attainable through the increase in calories that active people need. However, too much or too little of a nutrient can be dangerous to one's health.

2.10 When a person wants to assess his or her diet for nutrient intakes, it is recommended to average at least 3 days to calculate daily nutrient intakes since food intakes vary from day to day. However, in the case of athletes, based on the studies carried out at National Institute of Nutrition (NIN) it is suggested that 7 days dietary records are necessary in each of the training phase (transition, pre-competition and competition phase including post-competition rest phase) as the training intensity vary considerably from day to day basis.

Fuel for Muscular Activity

2.11 Muscle cells utilize the energy provided by fats, carbohydrates and protein. In sports activities, however, protein as a source of energy is not desirable. Muscle fibers can be divided into three categories, depending on their color and speed of twitching. Type-I (Slow Oxidative or Slow Twitch) is usually used during endurance sports and is reddish in color representing the increased oxygen flow. Type-IIa (Fast Oxidative Glycolytic) is pinkish in color and is used during intermediate activities. Type-IIb (Fast Glycolytic or Fast Twitch) is white and is used in more anaerobic type activities. Muscle fibers are used or recruited generally in the order of Slow Oxidative (SO), then Fast Oxidative Glycolytic (FOG), then Fast Glycolytic (FG). Muscle fiber contraction is believed to involve the proteins Actin and Myosin contracting in the myofibrils, then Calcium ions releasing in the sarcoplasm of the cells with nerve impulses that stimulate muscle contraction.

2.12 Every muscular contraction needs energy which is derived from conversion of Adinosinetryphosphate (ATP) to Adinosinediphosphate (ADP). But its source and rate of utilization depends on the intensity of activity. For example, at rest ATP transfers from fat to muscle. At the beginning of exercise, energy is derived from Creatine Phosphate (CP). Once the steady state is attained (5-15 minutes), the source of fuel is mainly from carbohydrates of muscle and liver (i.e. glycogen) and fats from muscle and free fatty acids (FFA). Fat is the main source of energy for most ATP re-synthesis.

2.13 The source of fuels that are used during exercise mainly depends on the duration and intensity of exercise. Considering the exercise intensity, a mixture of fat, glucose, and glycogen are used in low intensity exercises; carbohydrates and lactate utilization (90-100%) in sub-maximal exercises; CP utilization and Lactate formation (Sec.). On the other hand, based on the exercise duration greatest glycogen depletion takes place where exercise duration is more rapid like in short-term high intensity exercises. After attaining steady state, glycogen contributes to the tune of 50-60% and rest from the fat. In case of marathon about 50% of fuel is utilized from fatty acids. **Certain sports activities need additional amount of glycogen storage to be spared during the events. In such situations appropriate carbohydrate loading techniques may be adopted if the carbohydrate stores are below normal. However, recent studies have shown that as along as the intake of carbohydrate is meeting the recommended levels, carbohydrate loading is not desirable since it will limit intake of other essential nutrients which are required for optimal performance.**

Protein

2.14 Protein is one of the most important nutrients in the maintenance of good health and vitality. It is of vital importance in the growth and development of all body tissues. It provides a major source of building materials for blood, muscles, skin, hair, nails, and glands, as well as for hormones, enzymes, and antibodies. The major sources of protein are given in Figure 1. A diet deficient in protein may contribute to a variety of symptoms. The consumption of too little and too much protein will have deleterious effect on health and performance of an athlete. Hence, utmost care needs to be taken when recommending protein allowances.

2.15 There are 20 total amino acids in which 9 are essential. All Amino Acids have an amine group and an acid group, but vary in their structure by their varying side chains. Proteins are made up of strands of Amino Acids linked together by peptide bonds to form proteins. The strands coil and fold to make a variety of proteins for various functions. The denaturation of proteins can occur by heat, acid, alcohol, and salts of heavy metal.

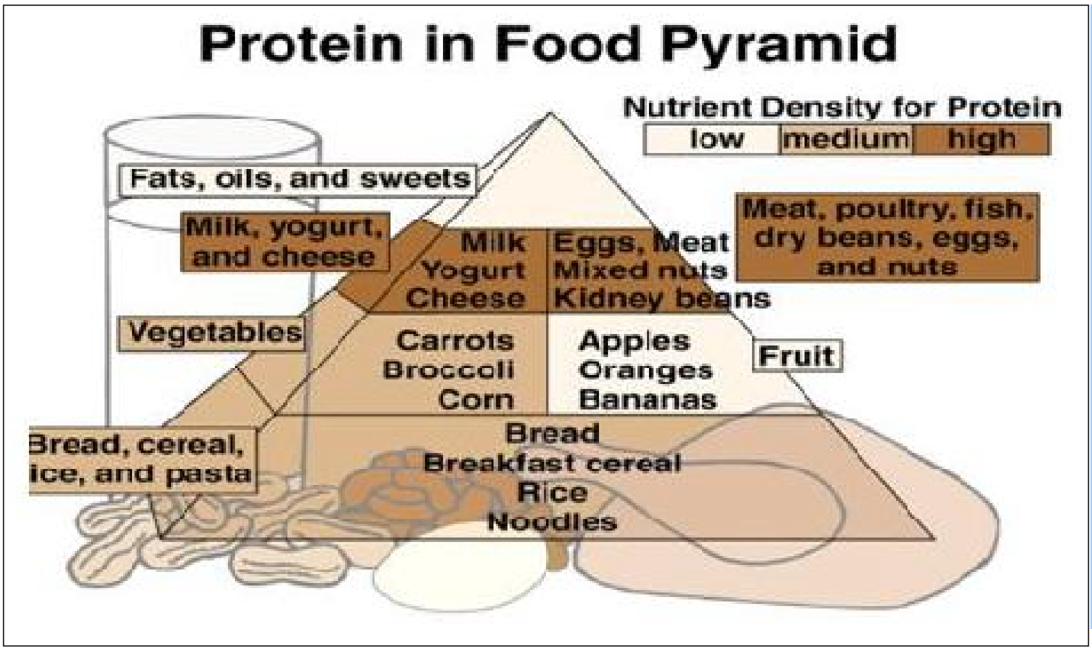
2.16 Protein digestion starts with the stomach acids denaturing protein and the stomach enzyme pepsin starting to split the protein chains. The pancreas releases the enzyme trypsin and the small intestine releases enzymes that further break apart proteins into tripeptides, then dipeptides, and further into individual Amino Acids. Absorption of the Amino Acids occur through wall of small intestine into the bloodstream and are carried to the liver, then to rest of the body.

2.17 The primary functions of protein are growth and maintenance of tissue, enzyme and hormone development, making antibodies (to fight infection), fluid and electrolyte and acid-base balancing, and energy (as a last resort).

Dangers of Too Much Protein

2.18 It is difficult **not** to get enough protein if one eats an appropriate amount of calories for his or her bodyweight. There are dangers of overdosing on 2-3 times the recommended amount of protein. Dangers are weight gain if too many calories are eaten, water loss (dehydration) if carbohydrates are not consumed, excess calcium excretion (which can lead to osteoporosis), and possible kidney problems from the burden of its excretion. In addition consumption of high animal protein over and above recommended daily allowance (RDA) (2 (RDA) is associated with the risk of heart disease and colon cancer.

Figure-1: Protein Sources Pyramid



Protein Requirements

2.19 Protein requirements and recommendations are based on many years of scientific research. Charts are established from these studies based on bodyweight, sex and age. Athletes do not generally need extra protein unless they are trying to gain muscle mass or they engage in endurance sports. The Recommended Daily Allowance (RDA) for protein for most people is 0.8 grams per kilogram of bodyweight and it is 1.0 to 1.5 grams per kilogram of bodyweight for endurance athletes and bodybuilders. Additional recommendations include increasing plant proteins for the added benefits and keeping the percentage to 10-15% of total calories for any person who is within their appropriate caloric range.

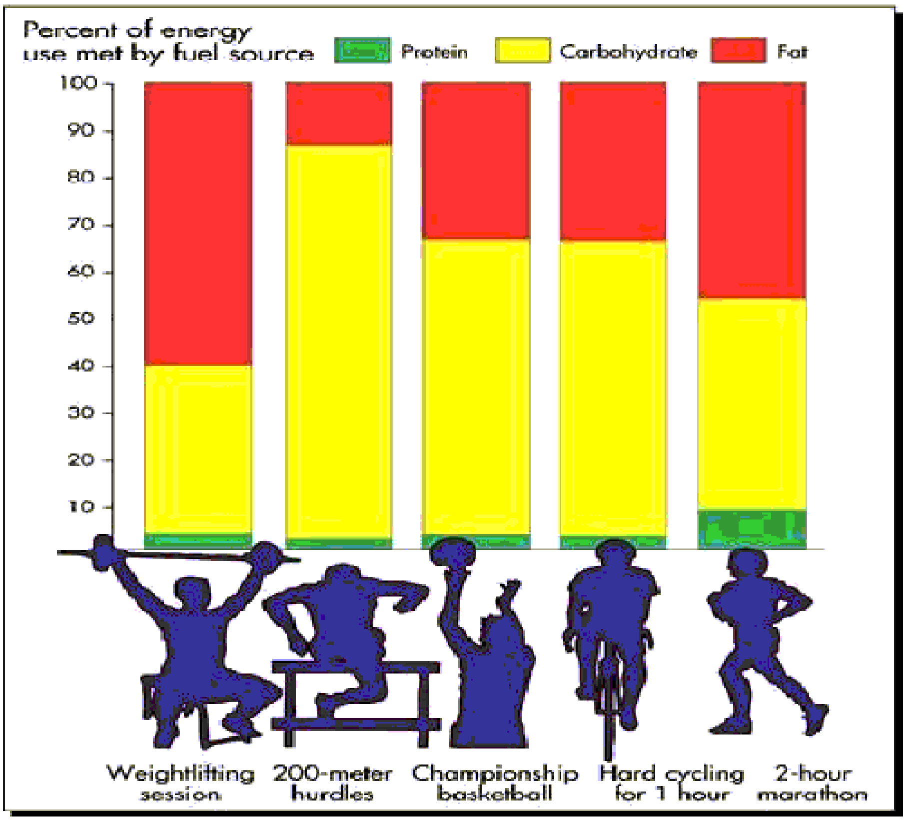
Table-1: Calculation of RDA for Protein

Calculating Protein Requirement for a Person Weighing 154 lb.
RDA for Protein = 0.8 gm of protein / kg of healthy body weight/day Therefore a 70 kg person needs: 70 kg (0.8 g protein = 56 g protein/day

Protein for Energy and Sport

2.20 The active body's use of proteins as a fuel (a minor source of fuel) to meet 2% - 5% of energy needs during rest and low/moderate exercise, while, it provides 10% - 15% of energy needs during endurance exercise. A carbohydrate-rich diet spares protein from being used as fuel.

Table-2: Fuel Use during Various Sports Activities



2.21 For a kg of body weight 1.2 gm of protein is generally recommended (up from typical 0.8 gm protein/kg body weight) and even up to 2.0 grams for individuals participating in certain events. Protein needs are easily met by a normal diet. Therefore, protein supplements are not at all necessary. Excessive protein has not been shown to be beneficial for athletes. Rather, such intakes may be deterious to performance However, in the menu planning for the athletes in the Indian diets protein intake may exceed 2 gm / kg body weight.

2.22 From Table 2, it can be observed that protein is the smallest percentage of energy use during sports activities.

2.23 Hard exercise increases protein needs. Intense exercise activates specific enzymes in the muscle that degrade the myofibrillar protein. Protein loss occurs through sweat and urine because of decreased absorption in kidney tubules during heavy exercise.

Carbohydrates

2.24 Carbohydrates are the preferred source of energy for all body functions and muscular exertions and are necessary to assist other foods in digestion, assimilation, and elimination. Carbohydrates differ greatly from one to the other.

2.25 Carbohydrates can be classified into simple or complex depending on the length of the saccharide chain. The term "simple" refers to the single or double molecule of a sugar (the monosaccharides and the disaccharides). Examples of monosaccharides in the diet are glucose, fructose, and galactose. These monosaccharides bond to form the disaccharides. Examples of disaccharides in the diet are sucrose, lactose, and maltose. A glucose molecule and another glucose molecule form maltose. Glucose and a galactose molecule form milk sugar, which is lactose. A glucose and a fructose (fruit sugar) molecule form sucrose (table sugar). Long chains of sugar or glucose units are polysaccharides such as amylose. Fiber is also form of complex carbohydrate.

2.26 Simple carbohydrates are sugar, honey, fructose, glucose, corn syrup, brown sugar and foods made with these sweeteners such as cookies, cakes, pies, candy, ice cream, and soda pop are simple carbohydrates and are sweet. Examples of complex carbohydrates or polysaccharides are grains, vegetables, fruits, peas, and beans. If carbohydrates have had their bran kernel and germ removed there is great loss of fiber and nutrients. Even the "enriched" grains do not replace all the lost vital components.

2.27 Carbohydrates are digested in the body with the help of enzymes that split polysaccharides and disaccharides into monosaccharides, which are the form that can be absorbed. Salivary amylase is a carbohydrate-digesting enzyme that is released by the salivary glands. The pancreas releases pancreatic amylase that continues this breakdown toward monosaccharides. The surface of the small intestine will contribute additional enzymes to complete the breakdown, and then the monosaccharides are absorbed through the wall of the small intestine in the jejunum section. Here, they will travel to the liver where they will all be converted to glucose for energy or storage. If a person lacks lactase enzyme that splits apart lactose (milk sugar), the lactose may remain in the small intestine and become fermented,

Table-3: Classification and Structure of Carbohydrates

Simple	Complex
Monosaccharides • Glucose • Fructose • Galactose **Disaccharides** • Sucrose • Lactose • Maltose	**Polysaccharides** • Amylose Fiber **Fiber** • Insoluble • Soluble

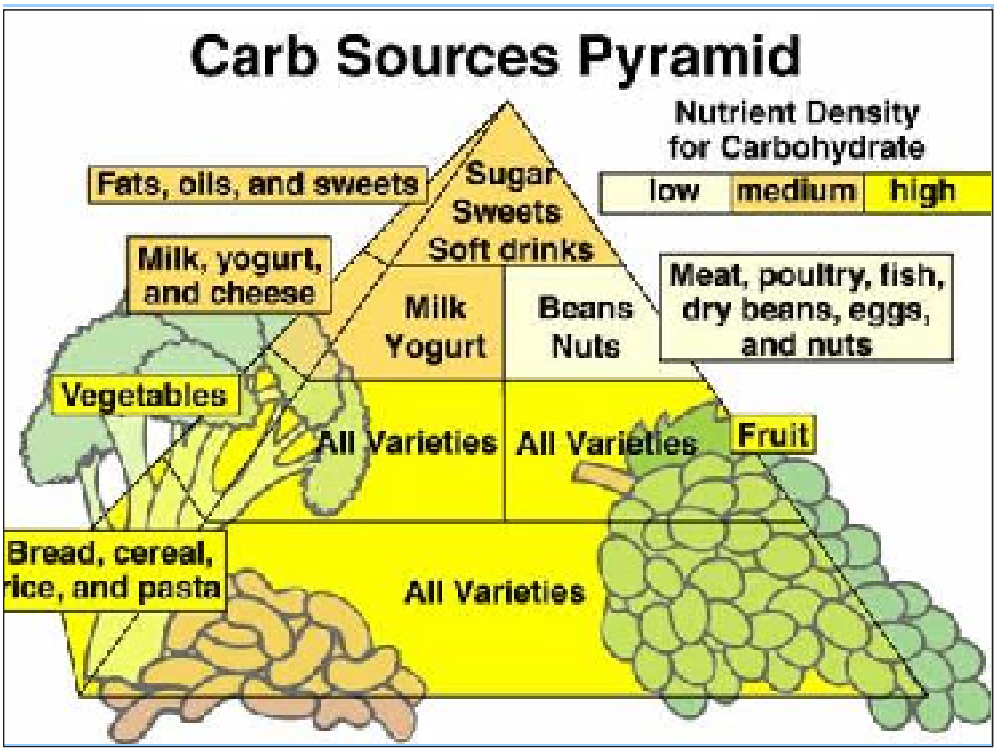
causing serious gastrointestinal pain. This condition is called Lactose Intolerance. Cow's milk is not a good source of calcium for individuals with lactose intolerance.

2.28 Several problems may occur with the consumption of too many simple refined carbohydrates such as unstable blood sugar levels, diabetes and hypoglycemia, obesity and weight problems, rapid pulse and trembling, headaches, anxiety, and confusion, tooth decay, insomnia, nervousness, and depression, and inadequate nutrient intake by replacing nutritious foods with the "empty" calories, "empty" meaning devoid of any nutrient value.

2.29 Once the monosaccharides are converted into glucose after being digested and absorbed, they have many functions in the human body, including blood glucose maintenance (80 calories), glycogen storage in the liver (400 calories) and muscle (1400-1800 calories), and serving as the primary brain fuel. Carbohydrates are essential for athletes, especially endurance athletes.

2.30 Healthful sources of complex carbohydrates are whole grains such as oats, barley, millet, rye, triticale, bulger, kamut, brown rice and products that have whole grains as the first ingredient (some examples may be waffles, cereals, bread, tortillas, and pasta; legumes such as lentils, split peas, and beans; fresh veggies and fruits which also have natural simple sugar-fructose). Less healthful complex carbohydrates are the refined ones such as white bread, and white noodles. Specific ideas for adding and preparing healthful carbohydrates (wholesome unrefined complex carbohydrates) for personal dietary program are essential. Focus should be given on **wholesome unrefined complex carbohydrates** in the menu planning for athletes as they are rich in fiber, rich in vitamins and minerals, rich in phytochemicals, have essential fatty acids, are rich in antioxidants, and promote satiety.

Figure - 2: Carbohydrates in Food Pyramid



2.31 A nutrient rich diet would help the athlete to maintain high energy reserves to perform better and postpone fatigue. Such diets also have other health benefits.

Estimated Requirements of Carbohydrates

2.32 It is generally recommended that at least 55% of total calories should be from carbohydrate for an average person (FAO/WHO/UNU, 1985, Technical Series No. 724). Athletes need total carbohydrate grams to be closer to the WHO recommendation in order to properly store enough fuel for their events, especially for endurance competition. A minimal daily amount of carbohydrates recommended for an athlete is 300 grams if the total intake is 2000 k.cal.

Fats

2.33 Fats are essential for good health. They constitute an important source of energy storage in the body, cushion and protect vital organs and carry fat-soluble vitamins like vitamins A, D. E and K. However excess consumption of fats, particularly saturated fats, can be injurious to health.

2.34 Fats can be derived from animal sources like meat, eggs, milk and milk products and also from vegetable sources like oils from a variety of seeds e.g. rapeseed, sunflower, etc. or nuts like peanuts,

2.35 In some foods oils and fats are visible. But in many other foods oils and fats are mixed with other food components and are not therefore easily identified. Such 'hidden' fats generally account for more than 70 per cent of the fat intake.

2.36 Fats can be classified into 4 categories viz. saturated fats, monounsaturated fats, polyunsaturated fats and trans fatty acids. The food sources of these types of fatty acids are indicated below:

Saturated: Butter, cheese, meat and meat products, full-fat milk, pastries, coconut oil and palm oil

Monounsaturated: Olives, rapeseed oil, nuts, avocados, canola

Polyunsaturated (Omega-3) Salmon, mackerel, trout, walnuts, flax seeds

Polyunsaturated (Omega-6) Sunflower seeds, wheat germ, soybean, corn

Trans fatty acids: Baking fats like hydrogenated vegetable oils (Vanaspati), fatty meat

2.37 Moderate consumption of fat and a balance between saturated and unsaturated fats are desirable. For a balanced diet:

- reduce total dietary fat to less than 30 per cent of total calories
- reduce saturated fats intake to 10 per cent of total calories

Micronutrients

2.38 Apart from macronutrients like carbohydrates, proteins and fats, the body requires micronutrients minerals & Vitamin in small quantities for its proper functioning. Micronutrients are required in small quantities and include vitamins and minerals. These are required for:

- growth and repair of body tissues
- metabolic reactions
- immune functions and
- elimination of free radicals

2.39 There are 13 different vitamins some of which are water soluble and others fat-soluble. The first category includes vitamin C, B1, B2, B6 and niacin, which are involved in energy metabolism and folic acid and vitamin B12 which are involved in cell development. Deficiency of B-group vitamins can result in premature fatigue and inability to maintain heavy training program. The fat-soluble vitamins include vitamins A, D, E and K. Vitamins A, C and E have antioxidant properties. Antioxidants offer a defense against the damaging effects of free radicals. Excepting vitamin D, most other vitamins have to be received from diet.

2.40 Increased physical activity may necessitate higher input of vitamins particularly vitamins C, B2, A and E. But this increased input would come from diet if energy expenditure is met from energy input. For most athletes there is therefore no need for vitamin supplements. However in respect of athletes who have to restrict body weight and therefore their diet (e.g. gymnasts) there is likely to be inadequacy of micronutrients and supplementation will become necessary.

2.41 Losses of minerals can occur from strenuous exercises. Losses of iron and magnesium are likely from sweat particularly in hot conditions. If dietary intake fails to compensate for these losses athletic performance will be adversely affected. Hence iron, zinc and magnesium supplements may be necessary. But these should not exceed 1-2 times the RDA. Excessive intake can be toxic. Female athletes who train in hot conditions are likely to lose iron and calcium. They will require calcium supplements to maintain healthy bones.

2.42 There are a number of foods that contain different vitamins and minerals. Therefore, in the selection of diets for athletes these foods should be included from time to time. (See Appendix I)

2.43 It needs to be observed that many Indian athletes come from rural areas and from not-so-well-to-do families and may not have received proper nutrition in childhood. Inadequate and unbalanced nutrition results in lower height for age, lower weight for height and lower weight for age. National Nutrition Monitoring Bureau (NNMB) surveys indicate that micronutrient deficiencies are widespread and acute (see Appendix II). Hence, it is necessary to monitor micronutrient status of athletes and if deficiencies are located they should be made good through supplementation or through fortified foods.

Dietary Fiber

2.44 The recommendation for a healthy amount of dietary fiber varies between 25-48 grams a day for diets ranging from 3000 to 7000 k.cal per day. In some cultures and in ancient diets 60-100 grams of fiber was consumed. Both types of fiber, insoluble fiber and soluble fiber have health benefits such as reduced cholesterol levels, less colon disease, and the promotion of weight control. Therefore, the athlete's diet should include fiber rich foods to meet the recommended levels.

2.45 Some examples of fibers naturally found in foods are hemicelluloses, pectin, and gums. The foods with the highest amounts of fiber are beans, legumes, and peas. Fiber content is lower in cereal, flours, and products made from processed grains, potatoes, and yams. Most fruits, vegetables, seeds, and nuts are rich in fiber. Foods that contain no fiber are meat, milk, eggs, sugar, and alcohol.

2.46 In addition to the weight control benefit and reduced blood cholesterol and colon disease, fiber also benefits health by promoting softer, larger stool and regularity, by slowing glucose absorption, and reducing hemorrhoids and diverticula's. One of the recent discoveries is that the phytonutrients present in the whole grain in some cases exceed those in fruits and vegetables.

Nutritional Consideration for Athletes

2.47 Nutrition and the dietary requirements for sporting events require careful programming. The body requires food not only for energy but also for anabolic and reparative processes. The link between overtraining and a depressed immune state is also an area of recovery being addressed through nutrition. A poor or inadequate diet can lead to fatigue, irritability, and sometimes to eating disorders such as anorexia.

2.48 Training and diets will vary according to the type of activity being undertaken. Adequate intakes of complex carbohydrates are essential for all athletes, especially after crucial events lasting over one hour. Carbohydrate loading or 'super-compensation' practices are designed to maximize the storage of glycogen and prevent the early onset of fatigue. Re-hydration can also prevent fatigue and assist athletes to sustain the intensity of a training session.

2.49 All athletes require a well balanced diet containing the essential macronutrients from meat, fish, dairy products, fruit and vegetables, cereals and bread. Protein is especially important for muscle regeneration and the prevention of exercise-related anemia. In particular, athletes involved in anaerobic activities require additional dietary protein to facilitate training adaptation and recovery.

2.50 The interplay between the immune system, white cell production, the production of free radicals in respect of athletes involved in continual heavy oxidative metabolic activities, is complex. Antioxidants such as vitamins E, A and C provide protection against the action of free radicals, and dietary supplementation of these vitamins may assist athletes in maintaining heavy training loads.

2.51 Similarly, minerals are important for muscle regeneration. Muscle cell damage can result from strenuous training or alter the balance of sodium, potassium and magnesium within cells leading to chronic fatigue and tiredness. Extra intake of minerals and trace elements may be necessary to assist recovery, but synthetic supplementation may not be as effective as increased dietary sources, due to the reactivity of some elements and metals with other foodstuffs in the gut.

2.52 Special attention is required for food intake pre and post training, and during competition, to maximize energy stores, minimize fatigue and to assist with tissue regeneration.

2.53 There are no healthy or unhealthy foods - only healthy or unhealthy diets and dietary habits. It is important to enjoy thr food and to enjoy being active.

Vegetarian Nutrition

2.54 Vegetarian diets are common around the world and an understanding of this lifestyle choice can especially help non-vegetarians to be not only tolerant, but more accepting of those people whose cultures or beliefs include vegetarian diets.

2.55 Vegetarian diets include mainly grains, legumes, nuts, seeds, soy products, vegetables, fruits, oils, and sweets. A lacto-ovo vegetarian also eats dairy products and eggs; a lacto vegetarian includes dairy products, but not the eggs; an ovo-vegetarian includes eggs and no dairy products. There are many food guide plans available for vegetarians.

2.56 Vegetarians can meet all nutrient needs as easily as non-vegetarians. For instance, it is very easy to get enough protein from vegetables, nuts, grains, and beans. Iron and calcium are available in a variety of foods. Dark greens contains iron and calcium that are highly absorbable with the vitamin C. Equal in calcium and vitamin D to cow's milk is soy and brown rice milk. B12 is one nutrient that comes from bacteria in animals, but vegan sources such as nutritional yeast, fortified cereals, fortified soymilks, soy products, and dairy products can meet one's needs of B12. What is crucial for vegetarians is making nutrient dense choices in their foods. However, vitamin C gets destroyed while cooking. Please see Appendix I for food sources of vitamin C.

2.57 A balanced vegetarian diet is rich in fiber and complex carbohydrates, has less fat, cholesterol, and saturated fat. Vegetarian diets have to include wise selection of foods combination in order to ensure adequate intake of all nutrients. In general vegetarian diets are credited with better health maintenance mostly due to less accumulation of adipose tissues and other problems. People on vegetarian diets generally have lower risk of heart disease, diabetes, GI and colon problems, cancers, and osteoporosis.

Sports Supplements

2.58 Sports supplements including vitamin and mineral supplements should be taken only in case of their deficiency and only after consulting a Doctor and of prescribed potencies to avoid any adverse effect on health. Some athletes take excessive amounts of supplements under the mistaken belief that it will improve performance. They are not aware of long term consequences. Research studies suggests that vitamin and mineral supplements are unnecessary for the athlete receiving a balanced diet. However, there are still a large number of athletes who believe that the "racers edge" may be found in a tablet.

2.59 Following points need to be noted:

- While **calcium** is good for a woman's body, too much of anything can cause problems. The body has a natural mechanism for protecting against calcium overdose, but it can be over-ridden if more than 4 grams of calcium are consumed per day. To do this, a woman would need to be taking 3-4 times usual dose in supplement tablets a day. The two most serious effects of calcium overdose are renal damage and the deposit of calcium in other areas of the body besides the bones.

  Women who are already at risk for developing kidney stones should take caution about taking supplements. They can contribute to stone formation. Any woman taking supplements may get constipation and acid stomach. Calcium supplements can be involved in drug interactions with medications. Keeping total intake to 1500 mg/day virtually eliminates this problem.

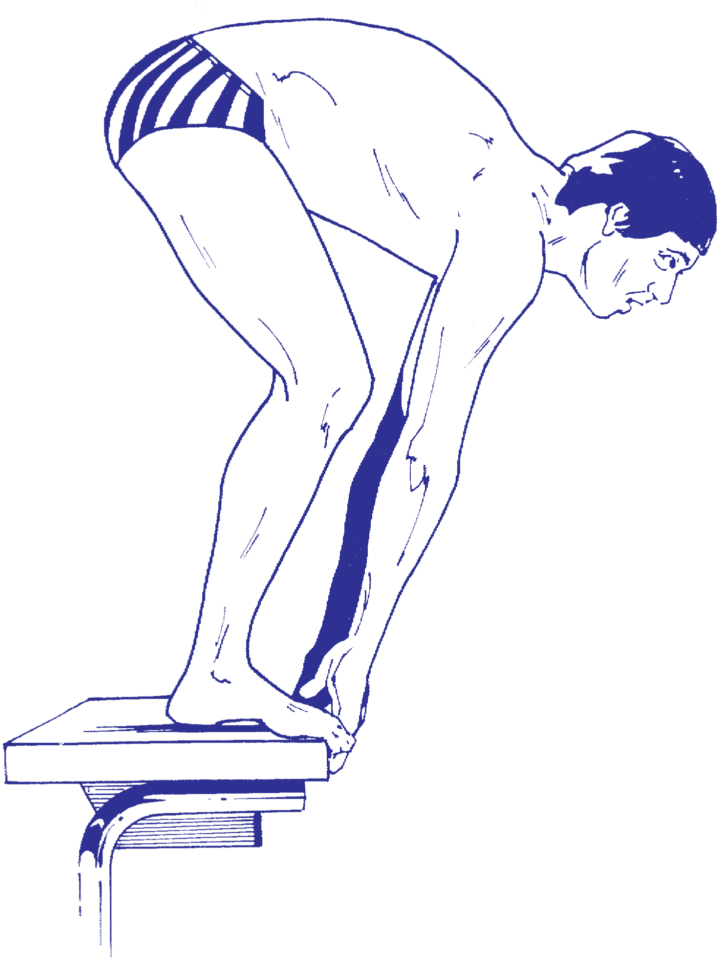
- While it is important to meet the body's requirements for **vitamins and minerals**, it is sometimes dangerous to exceed these needs. Taking extra vitamins and minerals or any other nutrient will NOT make an athlete bigger, stronger, or faster. Fruits and vegetables are particularly high in vitamins. Many are sources of antioxidants as well. Focus should be on high color (yellow-orange, red, deep green, and blue) choices. Blueberries have high antioxidant value. An athlete's meal plan has ample room to fit the five to nine fruit and vegetable servings recommended each day. Meat and dairy foods are especially high in minerals. Foods in the grain group contain both vitamins and minerals. Good nutrition and sound training methods yield improvements and better performance, not supplements.

- The majority of supplements have not been researched thoroughly, especially on teenage athletes. In addition, long-term studies on safety are not extensively available. Stimulating herbs such as guarana and yohimbine can cause **anxiety** and dizziness. One dangerous example is ephedra, which can have adverse effects such as nervousness, irregular heartbeat, and can be deadly in some cases.

- **Creatine supplements** may negatively affect kidney function and promote dehydration.

- **Amino acid** and protein supplements, while not dangerous, are an unnecessary expense when diet alone can meet protein needs. Hard training and proper nutrition, and food should be the first priority in an athlete's nutrition program.

2.60 Although the general implications would be that vitamin and mineral supplements are ineffective as ergogenic aids when added to the diet of an athlete who is well-nourished, there may be certain instances in which supplementation is warranted. For example, wrestlers on low calorie diets and high levels of energy expenditure may not be receiving a balanced intake of nutrients. Young male athletes and female athletes of all ages should be aware of iron-rich foods and include them in the daily diet. The female athlete who experiences a heavy menstrual flow may consider commercial iron preparations; hemoglobin and other hemotologic variables may be evaluated in order to determine the need for supplementation. More research is needed, particularly with large doses of the vitamin B-complex and vitamin C. Although some of the studies cited herein have used large doses, some athletes have been reported to consume massive dosages, for example, 10,000 mg of vitamin C daily. Unfortunately, there may be some adverse side effects of such massive doses, and it may not be ethical to conduct research with humans at those high intake levels. Do these massive dosages elicit a pharmacodynamic effect on some metabolic reactions that are favorable to physical performance? More research with vitamin E at altitude also appears to be warranted, as does iron supplementation to iron-deficient, but not anemic, athletes. As noted earlier, the research studies suggests that vitamin and mineral supplements are unnecessary for the athlete receiving a balanced diet.



III

Role of Nutrition in Sports Fitness and Performance

3.1 Sports nutrition assumes critical importance because long before deficiency symptoms start appearing, physical performance declines. It would not be prudent to think in terms of minimum needs to keep the blood levels or enzyme levels at normal limits. Rather attempts should be made to find out the level below which physical performance starts showing changes. The level, which permits the athlete to achieve the maximum possible physical performance should be the minimum level aimed in the sports nutrition.

3.2 An optimal diet may be defined as one in which the supply of required nutrients is adequate to cover energy expenditure, and for tissue maintenance, repair and growth. The nutritional needs differ from individual to individual based on age, sex, body size and composition, occupation, physiological condition etc. Nutritional requirements of athletes should take into consideration the specific energy requirements of a particular sport and phase of training as well as by the athlete's dietary preferences. There is no "one particular diet" for optimal sports performance. However, sound nutritional guidelines must be followed in planning and evaluating food intake of an athlete.

3.3. Many coaches make dietary recommendations based on their own "feelings" and past experiences rather than rely on available scientific evidence. This problem is compounded by the fact that athletes often have either inadequate or incorrect information concerning prudent dietary practices as well as the role of specific nutrients in the diet. Generally, athletes do not require additional nutrients beyond those obtained from a balanced diet. The extra calories required for exercise can be obtained from a variety of nutritious foods of the athlete's choice.

3.4 It is well documented that the rate of energy metabolism increases as much as 20 fold from basal level during peak performance. However, the athlete may not use this high level of energy for long periods. It is generally assumed that an average sports person needs more than 80% of his maximal capacity for short periods and 70% of capacity for considerable periods of time. It is also crucial at this juncture to maintain homeostasis and lactic acid tolerance in the blood. Besides this, the absolute level of maximal VO2 uptake is the most important measure of performance. Therefore it is essential to consider all these factors (physical, physiological, sport specificity etc.,) in recommending dietary allowances not only to improve the ultimate performance in each individual athlete, but also to achieve desirable body size and composition suitable to the event. In addition, the post event dietary needs of athletes are also important for repair and regeneration of the tissue and replenish the glycogen stores.

3.5 Thus, meeting the needs of players with regard to energy, proteins, fats, minerals and vitamins is very crucial. Majority of these nutrients perform very essential roles in the metabolic processes of the body. Deficit of any nutrient would impair performance. This may not be evident immediately. **Hence, it is important to maintain proper records of diets actually consumed by the players and changes in their body composition and physiological parameters in relation to performance. That would help in planning and combating malnutrition problems by modifying their diets time- to- time to achieve optimal performance.**

3.6 The nutrition composition for athletes' diet with special reference to energy contribution from carbohydrate, protein and fat varies from event to event i.e., 55-65% of carbohydrate, 12-15% of protein (of which 55-60% from animal protein) and 25-30% of fat. The ratio between these macronutrients has to be adjusted time to time depending on the needs of the individual athlete keeping in view event specificity so as to achieve desirable body size and composition, and optimal performance levels. (For relevant menu planning as recommended by NIN See Appendices V, VI A to VI F).

Definition of Energy Requirements

3.7 The energy requirement of an individual has been defined by WHO/FAO/UNU (1985) as 'the level of energy intake from food that will balance energy expenditure when the individual has a body size and composition, and level of physical activity, consistent with long term good health, and that will allow for maintenance of economically necessary and socially desirable physical activity'.

3.8 International nutrition standards for athletes do not exist. The standards utilized by scientists evaluating dietary intake of athletes include guidelines from their respective countries, WHO recommendations, and in many cases, the recommended dietary allowances established by the National Research Council. For the serious competitive athlete, concerns about energy go beyond health or socially desirable physical activity. It is imperative that energy intake supports the training and competitive schedules which will allow the athlete to achieve his or her personal best. Maintaining adequate energy levels, weight loss and weight gain can have profound impact on sports performance. Coaches, athletes, and sports scientists are all interested in the energy requirements of athletes and significant contribution has been made not only in identifying nutritional needs, especially energy, during the sports season but also during the active recovery phase, especially in the developed countries.

3.9 It is an established fact that nutrition plays an important role in athletic performance, apart from training and other related components. However, in the Indian context, sports nutrition is yet to be recognized as an important component of training program, and is being largely neglected. Unless proper attention is given to nutritional needs based on the scientific evidence it will not be possible for Indian athletes to match international standards.

3.10 In this direction, National Institute of Nutrition (NIN), Hyderabad; Netaji Subhas National Institute of Sports (NIS), Patiala; Defense Institute of Physiology and Allied Sciences (DIPAS) have made scientific studies to identify the nutrition needs of Indian athletes. Since 1983 NIN has been advising the Sports Authority of India (SAI), a premier sports agency in the country, as well as the Sports Council in Andhra Pradesh, from time to time, on sports nutrition and preparation of menus for the different sports disciplines.

NIN-Studies / Recommendations

3.11 The initial NIN recommendations of 1983 on sports nutrition were based on theoretical values and assumptions made by the experts in the field. Subsequently, in the year 1987, a sports nutrition workshop was held at NIN in collaboration with SAI. During this workshop it was decided that the sport events should be divided into five categories instead of two categories (power and non-power events) and that energy allowances for Indian athletes should be based on the energy expenditure levels as suggested by FAO/WHO/UNU (1985). This gave the direction to carryout systematic studies to evaluate the energy expenditure pattern of Indian athletes. During this time the Committee had used the available information on the energy costs of sports activities largely from the western literature. The information is given in the following Tables-4 and 5.

Table-4: Classification of Sports and Games According to Energy Expenditure

CATEGORY	EVENT
GROUP-I	POWER EVENTS OF HIGHER WEIGHT CATEGORY (80 KG AND ABOVE) WEIGHT LIFTING, BOXING, WRESTLING, JUDO, THROWING EVENTS
GROUP-II	ENDURANCE EVENTS: MARATHON, LOGN DISTANCE RUNNING, AND WALKING ROAD CYCLING, ROWING MIDDLE AND LONG DISTANCE SWIMMING
GROUP-III	TEAM EVENTS, ATHLETICS AND POWER EVENTS OF MIDDLE WEIGHT CATEGORY (65KG): HOCKEY, FOOT BALL VOLLEY BALL, BASKETBALL, TENNIS, SPRINTS, JUMPERS, BOXING WRESTLING WEIGHT LIFTING, JUDO AND SWMMING
GROUP-IV	EVENTS OF LIGHT WEIGHT CATEGORY: GYMNASTICS, TABLE TENNIS, YATCHING, BOXING, WRESTILING, WEIGHT LIFTING AND JUDO
GROUP-V	SKILL GAMES SHOOTING, ARCHERY AND EQUESTRAIN

Source: National Institute of Nutrition

Table-5: Average Body Weight and Energy Expenditure Levels Assumed and Allowance Suggested

EVENT CATEGORY	BODY Wt. (Kg)	ENERGY ALLOWANCES		CALORIES RATIO				
		kcal/kg/day	kcal/day	CHO	:	PROT	:	FAT
Group-I	85	70	6000	55	:	15	:	30
Group-II	65	80	5200	60	:	15	:	25*
Group-III	65	70	4500	60	:	15	:	25
				64	:	15	:	21*
Group-IV	60	60	3600	65	:	15	:	20
Group-V	60	50	3000	55	:	15	:	30

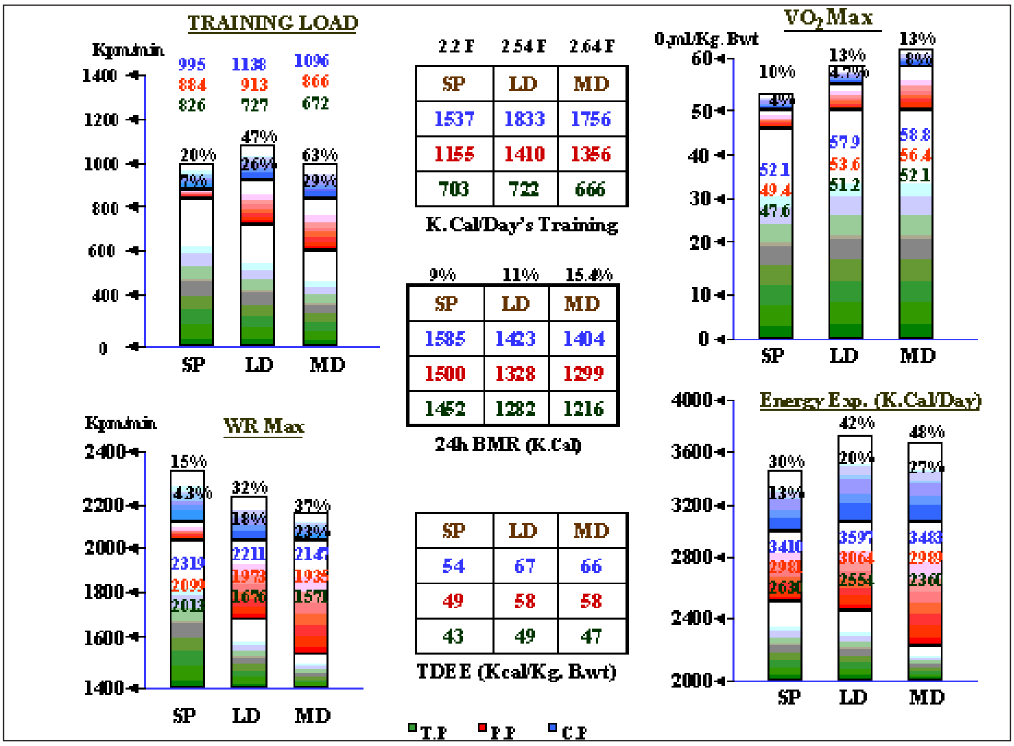
*= GLYCOGEN LOADING

3.12 To test the suitability of these recommendations systematic studies were carried out in a phased manner pertaining to energy expenditure pattern of Indian athletes (national & international level). The first such study on energy intake, energy expenditure and physical activity pattern was conducted on three selected groups of national level players (senior women hockey, junior men hockey and senior track athletes) representing India in the international events at J.N. Stadium, New Delhi during 1987. The study revealed that all the three groups of players were in the positive energy balance. However, there were differences in their intensity of physical activity pattern, as the women hockey players were undergoing intense training before the national meet, the men hockey players were in their pre-competitive rest phase before their departure to Russia and the women track athletes were in their post-competition rest phase immediately after their return from Rome. The mean total daily energy expenditure level was 54.8, 48.7 and 46.1 kcal, in women hockey, men hockey and women track athletes respectively when expressed in terms of unit body weight. While the mean body weights were 51.1, 57.6 and 40.2 kg in women hockey, men hockey and women track athletes respectively. Therefore, the study suggests that the energy needs of athletes vary based on the discipline (type of event) and season of sport in addition to age, body size and composition and sex. However, the so far available dietary guidelines/ recommendations for athletes were based on one time point only, mainly keeping in view the competitive phase of training.

3.13 To corroborate the results, further studies were initiated on track athletes (sprinters, middle distance and long distance runners) from Sports Authority of Andhra Pradesh (SAAP). The athletes were monitored in their three phases of training viz., transition phase (TP), pre-competition phase (PP) and competition phase (CP) on a continuous basis. The results of the study also confirm the earlier observations. In addition, it is evident from the study, that the Basal Metabolic Rate (BMR), VO2 max, Work Ratemax (WRmax) and energy expenditure levels increased with the increase in the training intensity from the TP to PP (7%-29% in different events) and further to CP from TP (20%-63%) in different events. The values and percent increases for various parameters are given in Table-6.

3.14 It is evident from the following (figure / Table), that the BMR and total daily energy expenditure levels increased considerably with the increase in training intensity from TP to CP. The total daily energy expenditure increased to the tune of 13% - 27% from transition to pre-competition phase and 30% to 48% from TP to CP i.e. the variation in terms of calories may range from 800 to 1100 kcal per day. Considering the TDEE in terms of unit body weight it can be observed that the values were found to be 43%-49% in TP; 49%-58% in PP; 54%-67% in CP. **Hence, it is evident that the energy allowance for athletes vary from phase to phase based on the intensity of training and type of event.** Therefore, it is suggested that different levels of energy requirements should be formulated for different phases and different events separately unlike the earlier recommendations of single requirements. Since suggested recommendations in the Appendices correspond to competitive phase of training only it is strongly recommended to reduce the requirements correspondingly based on the phase of training (TP and PP) to arrive at recommended requirements. This is crucial because if the athlete continues to consume

Table-6 : Training Intensity and Energy Expenditure



Source: Venkataramana Y et al, National Institute of Nutrition requirements given for competitive phase in transition and pre-competitive phases this will result in excess body weight which will hinder performance. Therefore, phase based nutrition intake requirements should be followed. To establish phase based requirements it is opined that further detailed studies need to be conducted on different sports events involving athletes participating in national and international events.

Studies on National Level Boxers

3.15 Boxing, wrestling and judo are basically power events that come under weight control category. Unfortunately, most coaches and athletes are not well informed on nutritional and weight control techniques and are following unrealistic means. There is a need to adopt scientific methods to achieve desirable body weight and composition by means of periodical assessment of anthropometry and body composition combined with proper and effective weight control techniques for athletes in these categories.

3.16 The information available from various sources on energy requirements of world-class athletes especially in weight category is too generalized and cannot be applicable to our athletes. Therefore, there is an immediate need to identify the RDA for energy for the boxers based on age, sex, event, phase of training and level of participation, to provide optimum energy to maintain desirable body weight, composition, good health so as to achieve peak performance. In view of the importance of the context, this study was carried out to assess physical, physiological efficiency and energy allowances of boxers during their different phases of training in the national camp prior to the national games-2002.

3.17 The results of the study reveal that there was redistribution in the body composition with a significant increase in lean mass, with reduction in fat mass, as a consequence of training. However, when compared to international boxers the percent fat was found to be higher by at least 8-10%.

3.18 It has been observed that unscientific weight reduction practices are adopted in weight category sports like boxing, weight lifting, wrestling etc. For example in the study on Boxers it was revealed that the energy intake level were substantially lower than the energy expended by them resulting in high negative energy balance, in an effort to reduce body weight. Such efforts to reduce weight combined with intentional dehydration within short period can have adverse repercussions on performance and subsequent recovery. Weight reduction has to be planned over a period of time by adjustments in energy intake and energy expenditure levels under strict scientific supervision.

3.19 The studies revealed, that there are large inter-individual variations in training intensity received by the athletes in a given training schedule. Therefore, it was suggested to construct individualized progressive program of training considering the athletes body weight, LBM and initial fitness levels to provide optimal / crest load to all athletes to achieve optimal work performance. The energy requirements were significantly influenced by variations in training load. Therefore, periodical evaluation of energy needs is necessary to recommend energy allowances to monitor desirable weight, composition and peak performance levels.

3.20 Even though, all the physical and physiological parameters improved with incremental training load, these athletes are far below the international standards. Therefore, it is essential to select the athletes based on scientific evaluation with better physique, endowed with innate physiological efficiency and nurture them with proper scientific training and adequate nutritional inputs to achieve high level of athletic performance in years to come.

3.21 In conclusion, based on the studies carried out at NIN, it is evident that, the BMR and total daily energy expenditure levels increased considerably with the increase in training intensity from TP to CP as shown in Appendix-III. Therefore, there is an immediate need to re-evaluate/modify the recommended energy allowances for Indian athletes from the existing norms and to incorporate phase wise allowances so as to provide optimal nutrition for maintaining desirable body weight and composition, thereby achieving optimal performance. Further, multi-centric research studies need to be taken up covering the Indian athletes representing in both national and international events so as to evaluate and recommend nutritional requirements. To facilitate this national goal, a "Sports Nutrition Cell" may be established at NIN.

Nutrition for Female Athletes - A Special Consideration

3.22 The ideal diet is based on the woman's weight and consists of percentages of various food types proportional to that weight. In general, for female athletes, the recommended allowances for macronutrients are similar to those recommended for male counterparts. The macronutrient requirements can be worked out as follows:

Carbohydrates: Take body weight in kilograms and then multiply it (her body weight) by 10. This gives the number of grams of carbohydrates in the diet. This makes carbohydrates about 70% of the woman's daily calories. An athlete's body needs more energy and the human body uses carbohydrates as its main fuel.

Proteins: Proteins intake (grams) should be 1.0 to 1.5 times the body weight. This means 10-15% of calories come from protein, although some have raised this to 20-25%.

Fat: About 20-30% of total calories should come from fat.

3.33 Care should be taken in the case of micronutrients especially iron and calcium, because of additional physiological demands of female athletes. In addition to iron and calcium the meals should be rich in, B-12, folate, and zinc. Diets should include: 30 mg of iron, 800 to 1,200 mg of calcium and 1.3 mg of B-12 a day. Calcium needs can be met by 3 to 4 servings of low-fat milk, yogurt, or other calcium-rich foods. Calcium absorption requires adequate amount of protein, lactose (milk sugar), vitamin D and acidic foods. If red meat is not eaten, iron and B-12 supplements may be required. Iron from meat, poultry and fish are better absorbed by body than iron from plant sources. Vitamin C promotes the absorption of iron from plant sources. Tannins in tea and coffee hamper the absorption of iron from food and therefore, they should be taken in between meals and not along with meals.

3.34 Most women don't get enough of folate a form of B vitamin, and folate deficiency is linked to severe neural-tube defects in newborns. This connection is so strong that the U. S. Center for Disease Control and Prevention and the U.S. Food and Drug Administration now recommend that women take 400 micrograms of folate daily.

3.35 Soybeans can be added to the diet as they contains phytoestrogens, which research has shown can significantly lower bad (LDL) cholesterol and raise good (HDL) cholesterol.

3.36 Weight training is important to the female athlete. Women need to balance upper and lower body weight to achieve overall body strength. Weight lifting programs that are done 2 or 3 times a week increase bone density, decrease fat, and improve muscle definition. They can improve sports performance, as well.

Iron Deficiency Anemia

3.37 Studies show that more than 50 percent of all women runners are deficient in iron. Sagging iron levels result in fatigue and poor endurance, since the blood is unable to carry oxygen as efficiently to working muscles. Feeling chilled or cold may be another sign that iron is low. Though losses of this important mineral occur during menstruation and in a few other small ways, lack of iron in the diet is the most likely cause of deficiency, as studies show that women distance runners usually get less than the RDA of 15 milligrams.

3.38 It is recommended that hemoglobin levels, a test indicating anemia (measuring values called hemoglobin and hematocrit) should be frequently monitored. Ferritin testing should follow any low hemoglobin/hematocrit readings in female athletes. Training causes the fluid in the blood to increase. This "dilutes" the red blood cells (RBC), so there appears to be an anemia when there is not. When female athlete is anemic, her performance level deteriorates. Therefore, iron-rich foods, dietary supplements, and vitamin C (which helps absorb iron) should be included in their diets

Female Athlete Triad

3.39 A serious problem for female athletes is known as the "female athlete triad". It is a shared relationship with eating disorders, menstrual problems, and stress fractures. It begins with severely restricted eating and intense workouts. These three issues are of growing concern, especially due to the increasing pressure on adolescent girls to maintain an "ideal" body weight.

3.40 Female athletes need to feed their bodies well if they want to prevent the problems of the triad. They need to eat many, small, low-fat meals. Small meals eaten often will stop hunger pangs, provide fuel and fluid for workouts, and increase the metabolic rate. They should eat five times a day, i.e. three meals and two snacks. Studies have shown that this helps in keeping the weight steady, improves memory, cognitive skill and work performance.

3.41 **Amenorrhea** is the lack of menstrual periods. A larger number of female athletes have amenorrhea as compared to 5% of women in the general population. An estimated 25 percent of women runners become amenorrheic at some point. Why athletes sometimes stop having their periods or stop having them regularly is not understood, but it is a well-known phenomenon. The decreased estrogen levels associated with amenorrhea may be the cause of premature osteoporosis found among female athletes.

3.42 The possible changes required to resume menses include exercising 5 to 15% less and eating a little more. If training is totally stopped, as may happen in case of injury, period may be resumed within a few months. Some amenorrheic athletes have resumed menses by simply exercising less and gaining no weight or gaining less than 2 kgs. This small amount of weight gain is enough to achieve better health.

Nutrition For Junior Athletes

3.43 Special attention has to be given to the nutrition requirements of junior athletes. The dietary needs of children and adolescents differ from those of adults. The diet has to be such that it should take care of their growth and maturation. As they grow and reach adolescence, changes take place in the body: body composition changes, rapid growth takes place, and sexual maturation is achieved. Girls gain more body fat than boys and boys gain twice as much muscle mass during puberty. The following factors need to be taken into account by parents and coaches:

- The energy requirements for junior athletes will be different than the energy requirements for adults. While working out the energy requirements, a child's age, physical activity, weight and height should be taken into account.
- Children and adolescents require more protein than adults for growth to take care of development of muscle mass, muscle regeneration and additional requirements due to sports activities. Protein intake should be 15-

20% of total energy consumed and up to 2g/kg body weight in male teenage athletes.

- A variety of foods should be consumed by children and adolescents and this would take care of micronutrient requirements including iron, calcium, and zinc. However, in India, micronutrient deficiencies are widely prevalent and the deficiency can increase during adolescence and will adversely affect sports performance. Therefore, all care needs to be taken to ensure that micronutrient requirements are fully met. This can be achieved through consuming fortified foods or in specific cases, through supplementation.

- The diet of young athletes should consist of dietary fiber intake such as high fiber cereals, whole grain breads, legumes and fruits and vegetables. The dietary fiber requirement can be arrived at by adding 5g to the age for children older than two years.

- Adequate amount of fluids should be taken by children to have better regulation of body temperature and to prevent dehydration and complications arising from it. Fluids can be in the form of water and sports drink. The latter has the added advantage of providing carbohydrates for muscle energy, electrolytes, and will appeal more to children due to taste and flavor.

3.44 Care needs to be exercised to ensure that junior athletes are getting adequate nutrition for growth and sports performance through their diet and they are not cutting back on calories as it would have severe impact on their health such as menstrual problems, low bone density and stress injuries. It is important to ensure that children start their day with breakfast, have snacks in mornings and evenings, lunch and dinner at regular times and have plenty of fluids. A healthy and growth promoting diet should include cereals, milk and dairy products, lean meat, fish, poultry, eggs and legumes, fruits and vegetables.

IV

Body Composition

4.1 Optimal body dimensions are one of the most important pre-requisites of physical fitness and performance. Adaptation to exercise is manifested by changes in body weight, body build and body composition, and by changes in the absolute and relative aerobic capacity. It would be interesting to observe trends in performance changes in different sporting/athletic events especially in those where the intensity and regimen of training program and achieved results were enhanced most profoundly. Body composition data of athletes are very scanty, and it would be useful to define these changes more precisely because their analysis could contribute in a significant way to the definition of the optimal morphological type and measures leading to desirable changes to improve athletic performance.

4.2 Body composition reflects the overall long term nutritional status of an athlete, and lean body mass (LBM) is one of several important parameters that can influence performance on any given physical task, especially sporting and athletic events. The variation in intensity and duration of training brings about changes in body weight, composition, and metabolic and physiological parameters. Therefore, the periodic evaluation / accurate appraisals of body composition in relation to the amount of training given provides an opportunity to assess current nutritional status, training adaptability of an athlete and metabolic readiness to handle near maximal work for longer duration without fatigue. This would help the coaches to manipulate the training program to achieve optimal or desirable body weight, body composition and thereby peak performance levels. Hence, studies were carried out at NIN to identify the variations in body composition profile (LBM and fat mass) with incremental training load from TP to CP and in turn its relationships to VO2max and maximal work performance.

4.3 The results indicated a significant ($P<0.001$) increase in LBM by 4.7%, VO2max (18%) and maximal work performance (WRmax) by 37% from TP to CP. The change in training during the transition phase was 1.6 fold for intensity and 2 fold for duration. In addition, there were highly significant correlations between LBM and VO2max, and WRmax and VO2max. Thus, this study proved that the body composition is an important component in training-induced adaptations, and may influence various physiological parameters resulting in an enhanced maximal work performance.

4.4 Body composition and weight are two of the many factors that contribute to optimal athletic performance. Taken together, these two factors may affect an athlete's potential for success within a given sport. Most athletes require a high strength to weight ratio to achieve optimal athletic performance. As body fat adds to weight without adding to strength, less body fat percentages are often emphasized for better performance by many researchers.

4.5 In order to achieve desirable weight, composition and peak performance athletes undergo different phases of training prior to the actual competition by manipulating intensity, duration and type of training, apart from changes in dietary schedules. Hence, periodic evaluation of body composition changes and in turn physiological profiles provide important guidelines for appropriately developing a progressive program of training.

4.6 Regular involvement of athletes in physical training has led to considerable alterations in body composition, and is closely related to the aerobic capacity and maximal work rate of athletes. Similar observations were made in the studies carried out at NIN, where the duration and intensity of training received by the athletes increased considerably from transition to competitive phase of training. Such changes coincided with an increase in body weight and in LBM. This in turn improved their aerobic capacity and maximal work performance from TP to CP.

Influence of Body Weight on Performance

4.7 Athletes undergo a series of exercises during their different phases of training to attain optimal body size, composition and peak performance. These exercises are ambulatory and non-ambulatory in nature. The body weight influences greatly on the work rate in case of ambulatory activities where the athlete has to carry his/her own body weight, than in non-ambulatory activities. This would greatly influence energy output, work performance, and intensity of training received by the individual athlete within the given team. Therefore, it is imperative to consider the type of training received by the athlete, whether involving ambulatory and or non-ambulatory activities for assessing energy needs of an athlete, and formulating individualized training schedules to achieve peak performance.

4.8 A multi-stage exercise test on treadmill or bicycle ergometer will provide a measurement of the rate of work intensity an individual athlete is able to tolerate without symptoms of fatigue and ECG abnormalities. The work rate is dependent on the subject's body weight in treadmill exercise (TE) and independent on cycle ergometry (CE). The energy output per kilogram and km/hr is more variable in TE as it changes with the speed of walking and running, than it is at a given work load during CE. The energy output on the bicycle ergometer is independent of body weight. Therefore, usage of both treadmill and bicycle ergometer is essential to study the influence of body weight on energy output and work performance. Each and every type of exercise is a unique situation. However, all forms of muscular activity increases metabolic rate, and therefore, it is of interest to analyze oxygen consumption, transporting systems and other related physiological changes. It is evident that the variations in physiological demands are caused by the workload intensities that are in turn brought about by variations in the body weights.

4.9 In the Indian context, it can be observed that, in most training situations, athletes of the same event and age are receiving similar type of training schedules. This leads to variation in training load received by the athletes, because the athletes with higher body weights receive higher workload than athletes with lower body weights, as their body weight adds to the training workload. Therefore, for a given training workout, the load received by the athletes with lower body weight may not be sufficient to meet the physiological demands of the competition.

4.10 In order to assess the influence of body weight on training load, and in turn its relationship to physiological responses, twelve national level male athletes were subjected to two types of ergometry (Treadmill and Bicycle Ergometer). Anthropometry and body composition variables were measured at rest, and physiological variables were measured during and in recovery from graded exercise tests (GXT). The quantification of training load was done by the time-allocation pattern (TAP), combined with heart rate and oxygen consumption. Results indicated in Table 7 reveal that there was a 1.3 fold higher work rate with increased oxygen consumption and heart rate, and slower rate of recovery from treadmill exercise compared to cycle ergometry. Moreover, it was also observed that athletes with higher body weight were receiving higher workloads on the treadmill than their lean counterpart within the team. Similar results were observed in the training schedules through TAP, where the athletes with lower body weight were receiving 23% lower training load resulting in lowered physiological and work intensities as compared to their heavier counterparts, despite undergoing similar training protocol. **Therefore, this study clearly suggests that consideration of body weight component in the formulation of training program is also essential to achieve optimal sports performance.**

Table-7: Quantification of Training Intensity (n=12)

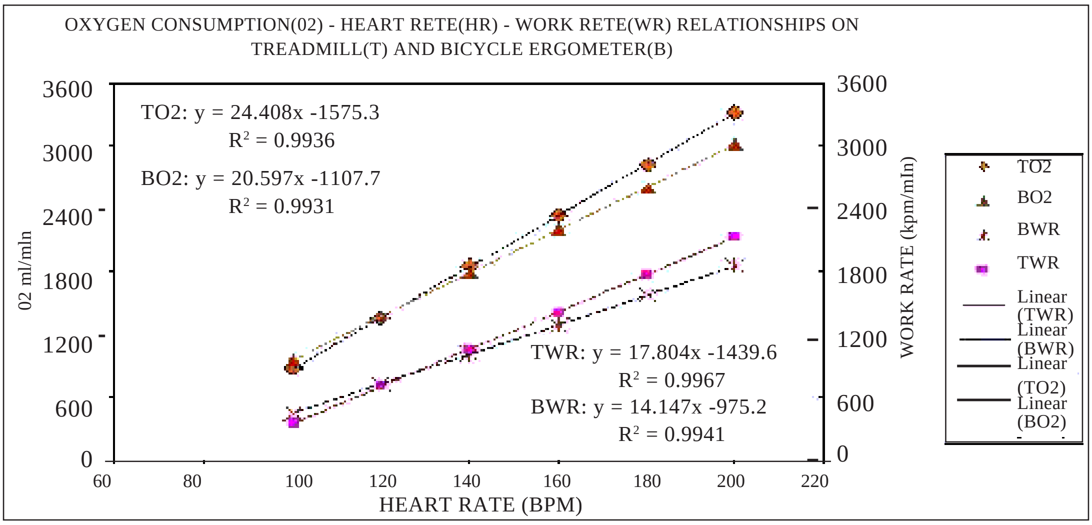
Group Body	*Weight (Kg)*	*n*	*Duration (min)*	*Work Load (kpm/min)*
1	63.9 ± 4.18	4	95 ±10.01	931 ± 19.98
2	57.8 ± 1.21	4	95 ±4.04	831 ± 47.57
3	51.8 ± 1.69	4	95 ±3.79	722 ± 89.31
Significance Levels	***1,3 & 1,2 **2,3		NS	***1,2 & 1,3 **2,3

Values are means ± S.D; *** $p<0.001$; ** $p<0.01$; NS=Not significant

Source: Venkataramana Y et al, National Institute of Nutrition

4.11 Such studies have clearly demonstrated the positive correlation between body weight and energy expenditure in a given activity. They also indicate the variations in quantum of load received by the athletes with different body weights within the given training program. This would help coaches to modify training intensity and duration to give optimal load to every individual athlete within the team.

Figure 3: Influence of Body Weight on Dual Exercise Testing



HR	100	120	140	160	180	200
TO_2	865.4	1353.6	1841.7	2329.9	2818	2306.4
TWR	340.8	696.9	1052.9	14.09	1765.1	2121.2
BO_2	952	1363.9	1775.9	2187.8	2599	3011.7
BWR	439.5	722.5	1005.4	1288.3	1571.3	1854.2
TO2Watt	2.54	1.94	1.75	1.65	1.60	1.56
Bo2Watt	2.17	1.89	1.77	1.70	1.65	1.62
TO2P	8.65	11.28	13.15	14.56	15.66	16.53
BO2P	9.52	11.37	12.68	13.67	14.43	15.05

Source: Venkataramana Y et al, National Institute of Nutrition

4.12 The usage of dual exercise test (DXT) would definitely help the coaches, researchers and sports nutritionists to identify scientifically, the influence of body weight on the quantum of workload and in turn associated physiological responses and energy needs. Apart from this, dual exercise test would also provide information regarding energy output of the training load and form an important baseline for the formulation of sound program of diet especially the energy allowances, since diet plays a major role in achieving desirable body weight, composition and optimal performance.

4.13 It is evident that body weight greatly influences maximal work performance, as is apparent from the close correlation between body weight and maximal work performance (a person with higher body weight receives higher intensity of work load than his low body weight counterpart would) when subjected to a given exercise intensity. The additional workload caused by higher body weight in turn increases the demand of cardiovascular and respiratory systems. As a result, oxygen consumption levels, minute ventilation and oxygen pulse significantly increase.

4.14 It was observed that athletes of a particular event were undergoing training with similar types of training schedules during their practice sessions. As such athletes with lower body weight were receiving lower work load/training intensity, resulting in attainment of lower physiological and work efficiencies. **Therefore it can be concluded that the identification of variations in amount of work load received based on body weight can help coaches and researchers to formulate individualized training program and to suggest suitable energy needs to achieve desirable body weight, composition and higher levels of work performance during competitions.**

V

Pre Event Meals

5.1 The pre-event meal is important and should have a definite focus on carbohydrate intake. The diet should provide adequate carbohydrates to maximize glycogen stores. With proper planning of the pre-event meal it is possible to prevent weakness and fatigue and ward off hunger. It is equally important to guarantee optimum hydration.

5.2 The contents of the pre-event meal will depend upon the time of the event.

Morning Event: The meal at night should be a high carbohydrate meal. The breakfast should be light consisting of, for example, cereals with non-fat milk, fresh fruit or juice, toast, low fat yogurt, etc.
Afternoon Event: The dinner at night and the breakfast in the morning should be high carbohydrate meals. The lunch should be light and consist of salads, sandwiches, fruits, juices etc.
Evening Event: The breakfast and the lunch should be high carbohydrate meals followed by light meal or snacks like pasta, soup, baked potatoes, yogurt, etc.

5.3 It needs to be mentioned however that no one food or group of foods works for every one. Each athlete has to discover at the time of training which food/foods work best. Further, food choices should vary with the intensity and duration of the event. (Appendices VII A-C).

VI

Fluid Balance for Optimum Sports Performance

6.1 Water is critical for the proper functioning of "body". Hence, it is important that the loss of water through sweat and urine is made up from adequate consumption of water and other fluids.

6.2 Water is required for a variety of reasons:

- **It transports nutrients and gases to cells, wastes from cells, as also other substances**
- **It combines with viscous molecules to form lubricating fluids for joints, for smooth movement of food through digestive tract, etc.**
- **It helps maintain body temperature**
- **It maintains cellular shape, is an integral part of cell membrane, cushions organs and helps maintain body structures**

6.3 The total body water varies with age, sex, body composition, etc. Water is about 70-75 per cent of body weight is an individual with normal body weight.

6.4 Body water is made up of two parts, viz, water inside the cell or intracellular and water outside the cell or extracellular. The former contains high percentage of sodium and chloride and the latter a high percentage of potassium.

6.5 Maintaining normal blood osmolarity is vital. The body mechanism is designed to ensure fluid balance up to a point. For instance, a small rise in blood osmolarity causes thirst. Similarly, the pituitary gland sends out messages which cause the kidneys to minimize urine volume.

6.6 During exercise 80% of the energy metabolized in a hot environment is liberated as heat in active muscles. The heat is transferred from warm muscle tissue to the blood, and is then transferred to the skin, where it is dissipated to the environment. The body increases the dissipation of heat to the environment by redirecting cardiac output, regulating skin blood flow and altering the rate of sweat secretion. If this heat is not removed from the body's core, it may result in a potentially dangerous increase of internal temperature.

6.7 Thirst alone is not a good indicator of the need for fluids. Research demonstrates that exercise in hot adverse conditions can cause dehydration in as little as 15 minutes. Drinking when in a dehydrated state can cause gastrointestinal distress. Athletes who say they cannot drink during a workout because it gives them a stomach ache may be allowing themselves to become dehydrated before they take their first drink.

6.8 The time required for fluid to move from the mouth to the sweat glands not only includes uptake at the intestine, but also includes the rate at which fluid empties from the stomach. Factors that increase stomach emptying include: carbohydrate content (optimal 6 to 10%), upright (versus seated) posture, low (versus high) exercise intensity and mild (versus hot) environmental temperature A small concentration of carbohydrate will encourage rapid absorption, but too much carbohydrate will slow gastric emptying and can result in distress.

Consequences of Dehydration

6.9 Depending upon its degree dehydration can result in 'heat cramps', 'heat exhaustion' and 'heat stroke'. Heat cramps begin as feeble twitchings and progress to localized contractions of skeletal muscles of the legs, arms, or abdomen. They occur in one motor unit and rarely involve an entire muscle. They are most often observed during repetitive, high intensity exercise when athlete has lost a large volume of sweat.

6.10 Heat exhaustion primarily results from sweat loss and/or inadequate fluid intake. It is a form of shock due to depletion of body fluids. When dehydration (especially greater than 3% of bodyweight) is superimposed on exercise heat stress, the cardiovascular system is simply unable to pump sufficient blood to meet all of the body's needs. Signs and symptoms can include: profuse sweating, "heat sensations" on the head/ shoulders/chest, weakness, "rubbery" legs, chills or gooseflesh on the neck and shoulders, anxiety, irritability, slight confusion, upper body swaying, nausea, vomiting, muscle cramps, fainting, rapid and weak pulse, pale or flushed skin, excessive fatigue, disturbance of vision and incoherence.

6.11 Heatstroke is caused by an "overload" of the body's temperature regulation system or a "failure" of the cardiovascular system during exercise in a hot environment. It results from extreme hyperthermia (core body temperature over 104oF). The loss of thermoregulatory control is a medical emergency. Medical care must be obtained at once; a delay in treatment can be fatal. Overload occurs when the rate of heat production exceeds the rate of heat dissipation, even in the presence of profuse sweating. Failure of the body's temperature regulation suggests dysfunction of either the brain, sweat glands of skin blood vessel aspects of human heat loss. First aid includes immediate cooling of the body without causing the athlete to shiver.

6.12 Symptoms and results at different levels of loss in body weight due to dehydration are given below:

Table-8: Symptoms and Results of Dehydration

1%	Thirst
2%	Stronger thirst, vague discomfort and sense of oppression, loss of appetite
3%	Increasing hemoconcentration, reduction in urinary output, dry mouth
4%	Increased effort for physical work, flushed skin, impatience, sleepiness, apathy, nausea, emotional instability
5%	Difficulty in concentrating
6%	Impairment in exercise temperature regulation, increases pulse and respiratory rate
8%	Dizziness, cyanosis and labored breathing with exercise, indistinct speech, increasing weakness, mental confusion
10%	Spastic muscles, inability to balance with eyes closed, general incapacity, delirium and wakefulness, swollen tongue
11%	Cirulatory insufficiency, marked hemoconcentration and decreased blood volume, failing renal function
15%	DEATH

Fluid Balance

6.13 Body water balance is maintained when water intake is equal to water loss. Heavy exercise sweat losses are about 1 to 2 L/h depending on intensity and duration, temperature, humidity etc. It is observed that for athletes who are physically very active and exposed to hot environments, fluid requirements are increased considerably to the tune of 5 to 16 L per day.

6.14 The body, within limits, maintains fluid and electrolyte homeostasis is spite of wide variations in intake and losses of water. But significant deficiency of water can cause dehydration. Therefore, consequences of body water deficits can increase the probability for impairing exercise performance and developing heat injury.

6.15 The amount of water needed to replace water losses varies from person to person and from day to day, depending upon the individual's metabolism, environmental conditions, activity level, and hydration status. Athletes should replace body water lost during training/competition using the guideline that 1 kg of body weight lost equals 1 L of water lost. Suitable fluid replacement is absolutely necessary.

6.16 Athletes exercising in a hot environment can lose approximately 30 ml of water every minute. Conversely, the body is only able to absorb similar amount of water every 3 to 4 minutes, hence, resulting in loss of about 500 ml of water every 20 minutes. A 3% loss of body weight in water can decrease the performance levels by 20-30%. To combat this, pre-event hydration is essential. Athletes should record their body weight before and after the event or training session. The differences in the body weight is equivalent to the water loss and should be replenished suitably.

- ***Pre-event Hydration***

1. **Athletes should consume 1.5 to 3 L of fluid above their normal intake the day before the event.**
2. **Athletes should consume 0.5 L of water 1-2 hours prior to the event and 0.6L of water / other fluids 10-15 minutes before event.**
3. **Empty their bladder 15 minutes prior to the event is a must.**
4. **Athletes should drink cool water during the event as it is absorbed faster and cools the body better than water at room temperature.**

- ***During-event Hydration .***

1. **Athletes should drink 150 ml to 250 ml every 10-15 minutes to maintain fluid balance.**
2. **Athletes should sip the water, and not gulp it down.**

Table-9 Fluid Replacement Guidelines

Timing	Amount	Type of Beverage
Before Activity		
1-2 hours	500 mL	Plain cold water
10-15 minutes	Up to 600 mL	Plain cold water, diluted fruit juice, glucose-electrolye drink
During Activity		
Every 10-15 minutes	150-250 mL	Plain cold water, glucose-electrolyte drink, diluted fruit juice
After Activity		
Begin immediately	Compensate loss in body weight (in grams) with equal amount of fluid (in mL).	Plain water, sweet-tasting beverage

1. Warmer fluids are appropriate when ambient temperatures are cool to cold. 2. Glucose and sodium are combined to promote rapid absorption from the small intestine. Diluted fruit juice and electrolyte-glucose drinks may be best when fluids and energy are needed immediately. They will also help with endurance exercises lasting longer than 90 minutes.

• *Electrolytes*

6.17 Electrolytes, like sodium and potassium, are important because they are used by the cells to maintain voltage across their cell membrane and carry electric impulses to other cells.

6.18 During physical activity sweat losses can be quite heavy depending on the environment. Along with water there is also loss of electrolytes, mainly sodium and potassium. These are replaced in food but if the loss is heavy it can be met from sports drinks (which generally contain sodium chloride and potassium chloride), tender coconut water, fresh fruit juices, sugarcane juices, preparation made of honey salt and water etc. Studies conducted by SAI have shown. coconut water and sugarcane juices as good source for electrolyte supplementation.

6.19 Carbohydrate replacement during exercise may enhance performance of sports and activities which typically deplete body carbohydrate store, by providing an additional fuel source for the muscle. Carbohydrate and electrolyte balance keeps low heart rate as well as low blood lactate level during exercise.

6.20 It is important that athletes monitor their own hydration status. They should be aware of the symptoms of dehydration, of how to use urine volume and color as indictors of hydration status and the importance of pre and post body weight measurement.

6.21 **The 'pee' test:** When fully hydrated large amounts of very pale yellow urine will be passed. Numbers 1-3 is Figure 4should be the aim. Dark yellow urine is an indication of dehydration although vitamin supplements containing riboflavin will color the urine dark yellow.

Figure-4

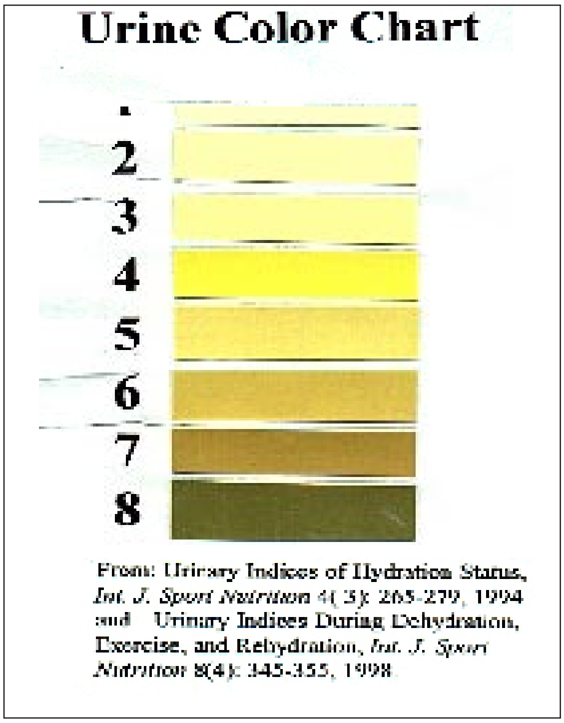
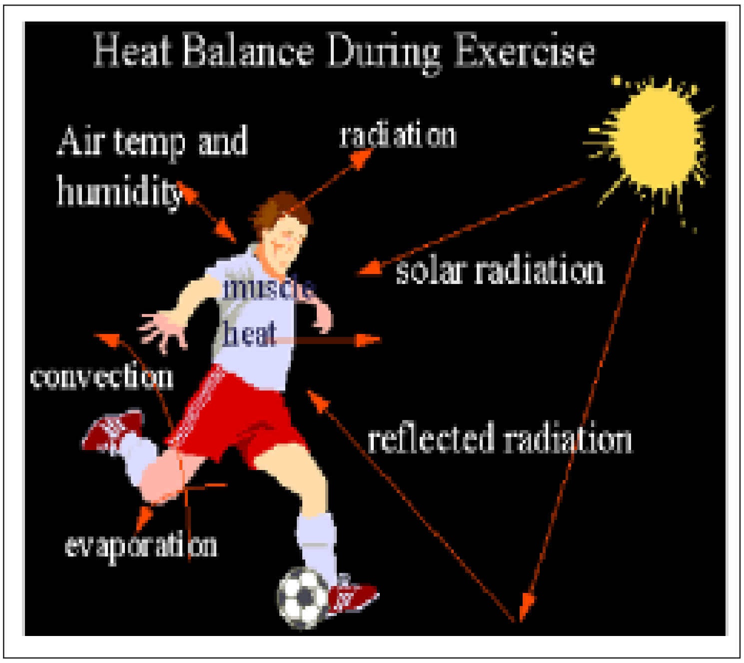


Figure-5

Exercise and Heat Balance



VII
Drugs In Sports

7.1 Use of **'Performance Enhancing Substances'** in athletes dates back to ancient times. Drugs have been probably used in sports as long as sports have been played, in order to gain an advantage over the opponents. There are multiple factors influencing athletes to use drugs, like social, psychological, physiological, economic and political. Types of drugs used range from therapeutic and performance enhancing drugs to typical drugs of misuse. Professional athletics has increasingly become a pharmacological testing ground, as athletes seek an edge over another and tries to keep one step ahead of doping tests. Several new drugs have come into the market in recent years and have altered the very face of sports.

7.2 Drug use is a major problem facing sports today. Soaring paychecks for top athletes and pharmacological advances have conspired to increase the prevalence of performance enhancing drugs in professional and Olympic sports in recent years. During the past three decades, the use of performance enhancing (ergogenic) substances in athletics increased at every level of competition believing that a specific drug positively influences skill, power, strength, endurance and responsiveness to training (improves exercise efficiency, or facilitates recovery process). It also reduces stress perception and delays fatigue which would in turn increase their competitive edge. As a result, use and misuse of drugs by athletes at every level of participation continues to be on the rise despite well documented "Scientific Evidences" now available indicating adverse effects on their health. **Thus, use and misuse of drugs in sports has gained much attention world wide even so** most athletes continue to use anabolic-androgenic steroids and other anabolic substances, erythropoietin (EPO), stimulants, painkillers, and a variety of illegal street drugs to increase their competitive edge.

7.3 Considerable efforts have been made by various amateur and professional sports authorities world wide today, to promote drug education (anti-doping) and testing programs to eliminate the use of performance-enhancing drugs in sports so as to achieve fair and healthy sporting atmosphere. Hence, the use of performance-enhancing drugs (doping) is strictly prohibited in both amateur and professional sports because they give users an unfair advantage and are potentially physically harmful and there have been certain instances of deaths of elite athletes. The international sports agencies have introduced strict and compulsory testing procedures wherein the athletes routinely undergo urine and blood tests following competitions to check for these drugs, and some have been stripped of medals or titles after testing positive for their presence.

7.4 The following broad categories of performance enhancing substances and methods banned by the International Olympic Committee (IOC) as of 2005 are:

1. Stimulants
2. Narcotic analgesics
3. Androgenic anabolic steroids
4. ß-Blockers
5. ß-2agonists
6. Alcohol
7. Diuretics and other masking agents
8. Agents with anti-estrogenic activity
9. Peptide hormones and analogues
10. Substances that alter the integrity of urine samples

11. Enhancers of oxygen transport
12. chemical & physical manipulation
13. Gene doping
14. Cannabinoids
15. Glucocorticosteroids

7.5 The following Table depicts various categories of drugs used in athletics, their possible action and side effects on the user athlete.

Table 10: Side effects of Drugs used in Athletics

Name of Drug	Reason Used	Side-Effects	Sports Associated
Anabolic Steroids - Artificial production of Testosteron, e.g. Nandrolone, Stanozolol	Development of muscle mass. Allow athlete to train longer by delaying fatigue	Increased aggression liver damage, heart problems **Men**: Reduced sperm count ; Impotence; Development of breasts; Shrinking of the testicles Difficulty or pain while urinating **Women:** Development of male features; Facial hair growth; Deepened voice; Breast reduction; Menstrual cycle changes.	Athletics, particularly (track and field) sprinting; hockey; football; baseball; swimming; weightlifting body building, all weight category sports
Stimulants - Activate the nervous systeme.g. pseudo-ephidrine, cocaine.	Speed up reaction times; delay tiredness; increase alertness; increase aggression.	Raised heart rate; raised blood pressure rise in body temperature and overheating	Cycling; football, hockey
Narcotic analgesics - Act as pain killers, e.g. opiates such as heroin, codeine and morphine.	Tolerate pain from injuries or activity; used to mask injury.	Addiction; induces a state of stupor; risk of further injury.	All sports.
Beta blockers - Used in patients with high blood pressure, e.g. atenonol and metaprolol.	Slows the heart rate steadies shaking limbs; induces feeling of calm	Reduces circulation; causes fatigue; can cause shortness of breath.	Snooker, drats shooting, archery.
Diuretics - Remove fluid from the body, e.g. frumil and burinex.	Quick loss of weight; removal of other drugs quickly from the body.	Dehydration, cramps, overheating, muscle weak-ness irregular heartbeat	All weight category sports Boxing, rowing, horse racing.
Peptide hormones - 'Naturally occurring' hormones, such as erythropoietin (EPO) and somatotropin (HGH).	Increased production of RBC; increases oxygen carrying capacity of the blood thus boosting endurance capacity; speeds up repair time; muscle growth, strengthen joints	Excess blood clotting; increased risk of heart attack or stroke; expands the size of athletes head and feet	Favors all endurance athletes; Long distance running; marathon; long distance cycling, cross-country skiing..
Blood doping - An infusion of blood to increase the red blood cell count.	Increased haemoglobin levels to facilitate more oxygen-carrying capacity in	Blood clotting; kidney failure	Running, cycling, water sports like rowing.

7.6 Our society is founded on competition and places much value on success. This leads to pressures producing a "win-at-all-costs" mentality. The athletes feel these pressures and often look for the "edge" from drugs and supplements, even if they are illegal or unsafe. Many coaches feel this leads to a "shortcut" type mentality rather than using hard work to improve their athletic potential. Athletes, parents, coaches, and trainers need to know that a sensible strength and conditioning program and a well-balanced diet with proper hydration are a reasonable alternative to a riskier shortcut training approach.

7.7 The sporting bodies like IOC, sports councils and national governing bodies world wide today are doing their best to eliminate drug use in sports. Hence, it is a primary responsibility of every stakeholder like the athletes, parents, coaches, and trainers not to encourage but in fact keep away the competing athlete from drug use in sports for achieving fair and healthy sporting atmosphere.

7.8 Finally, to achieve fair and healthy sporting atmosphere, all the stakeholders should keep in mind the following points.

1. **Drug use in sport gives user an unfair advantage.**
2. **Sports are natural and drug use is unnatural.**
3. **Morally the issue of drug use in sports is unfair and wrong.**
4. **Sport is a healthy activity and should not be polluted by products that will potentially damage health.**
5. **Drugs are taken by choice by athletes for ergogenic purposes and users should be severely punished, if tested positive.**
6. **If athletes rely more on the advice of doctors, it is possible to minimize or avoid drug abuse in sport.**

VIII
Recommendations for Healthy Nutrition for Athletes

1. The importance of nutrition in sports performance should be recognized and adequate facilities provided to ensure that athletes receive the right kind and amount of nutrition.

2. Selection of athletes should be done on scientific evaluation for better physic endowed with innate physiological efficiency. Proper scientific training programs should be devised with adequate nutrition inputs to maximize performance.

3. Body composition and body weight should be appropriate for the specific sport for which the athlete has been selected and these should be enhanced through training and nutrition.

4. In most training situations, athletes of the same event receive the same type of training schedules. This leads to variations in training load received by the athletes due to weight differences. Hence individual training schedules should be adopted.

5. There should be periodical medical check up of athletes to assess changes in body weight, body composition, micronutrient balance, lipid profile, etc. in response to the diet and training. For this purpose each athlete should maintain his dietary history and training schedules and submit copies to the training institute.

6. Diets have been prescribed for different categories of sports depending upon the body weight and energy needs. The latter will vary from 3000 calories for skill games to 7000 calories for power events of super heavy category (Appendices IV to VI).

7. Nutrition for female athletes is not very different from that or male athletes. But care has to be taken in respect of calcium and iron intake because of the additional physiological demands of female athletes. In addition, meals should be rich in B12, folate and zinc.

8. Nutrition requirements of junior athletes are different. In particular, they require more protein (2g per kg of body weight) to take care of development of muscle mass, muscle regeneration and the additional requirements due to sports activities. Junior athletes should start the day with breakfast, have snacks in the morning and evening and lunch and dinner at regular times, along with plenty of fluids. 9. Variations in diets have to be made depending upon the training phase. Based on the principle that calorie intake should be equal to calorie expenditure, the nutrient requirement will be lower in the transition phase than in the pre-competition phase and in the pre-competition phase less than in the competition phase. Corresponding variations in diets will have to be done depending on the training intensity.

10. Weight management in sports is critical. Excess weight can prevent peak performance. Hence weight has to be scientifically manipulated through exercise (energy expenditure) and diet (energy intake).

11. Diet has to be balanced in respect of macro nutrients and micronutrients. With balanced diet there is no need for food supplements. It is also found that excess of any nutrient, whether protein, iron, calcium, vitamins or any other, does not improve performance. On the contrary, excess vitamins or minerals can be toxic. However, in case of athletes who

have nutrient deficiencies, supplements would be desirable. But these should be administered on medical advice.

12. Weekly menus have to be prepared using the ingredients as indicated to add up to the recommended calories. The meals have to consist of a wide range of foods and fruits to offer a good choice to the athlete. The full package of nutrients can be available only when there is variety in food.

13. Athletes should eat only in the mess and should not eat anything from outside the mess. Otherwise control on nutrient intake will not be possible. Ultimately it is the athlete who decides what he eats. Hence educating the athlete about nutrition is important.

14. Nutritionists at the training centre should meet athletes in small groups along with their coaches to educate them about nutrition. It would be necessary for that reason that each training centre should have at least 3 nutritionists.

15. At present there is only one mess for all athletes in a given centre. It is not therefore possible to devise menus that will provide only the required calories for each category of sports. Hence there should be separate messes for each category. This will ensure that athlete's food intake corresponds to the energy expenditure for that sport during training.

16. The calorie value of one serving of each dish should be indicated on the food counter to help athletes make the selection/helpings of dishes according to total calorie intake. 17. Athletes come from different parts of the country and have different food habits. At least two types of cuisines should be available viz. North Indian and South Indian. These two kitchens can supply food to all messes.

18. The cooks in the kitchen should be properly trained to prepare variety of dishes which are both tasty and nutritious. Generally, it is found that food is overcooked and is too oily.

19. Athletes who go abroad to participate in international events find it difficult to adjust to food served there. Since it may not be possible to get the food they are used to, an orientation course should be initiated much before the event to introduce the athletes to the food that would be available at the venue of the event.

20. The pre-event meal should have definite focus on carbohydrate intake to maximize glycogen stores. If the event is in the morning the meal at night should be a high carbohydrate meal and the breakfast should be light. If the event is in the evening breakfast and lunch should be high carbohydrate meals followed by light meal or snacks.

21. Fluid balance is critical. In heavy training exercises and events there is considerable loss of water in the body. This loss of water should be made up continuously. With the sweat there is also loss of electrolytes. Hence it is preferable that fluid balance is maintained from sports drinks which contain sodium chloride and potassium chloride

22. Athletes should: consume 50 to 100 ounces of fluid beyond normal intake the day before the event 16 to 32 ounces of water 2 hours prior to the event, eliminate bladder 15 minutes prior to the event and sip 8 to 10 ounces every 15 to 20 minutes during the event

23. A 'Sports Nutrition Cell' should be set up at NIN to continuously evaluate nutrition requirements of different sports and make recommendations. Also the nutrition research facility at each Centre should be strengthened for making necessary field observations to evaluate the impact of training and nutrition.

24. 'Performance enhancing substances' (drugs) should be strictly prevented since they are injurious to health and have been banned by International Olympic Committee, sports councils, and other sports organizations.

APPENDICES

APPENDIX I

Foods Containing Vitamins & Minerals

Vitamins*

Vit A	:	Eggs, milk apricots, carrots, sweat potatoes, spinach, mangoes (all dark coloured fruits and vegetables)
Vit B	:	Whole-grains , fish, meat, poultry, dairy products, leafy green vegetables, Oranges, beans and peas
Vit C	:	Citrus fruits, tomatoes, cabbage, broccoli, lemon, green chillies, amla
Vit D	:	Fortified milk, fish, egg yolks
Vit E	:	Whole-grains, wheat germ, leafy green vegetables, sardines, egg yolk nuts
Vit K	:	Leafy green vegetables, liver, pork, dairy products

Minerals*

Calcium	:	Milk & dairy products such as yogurt, cheese, broccoli, liver, soy foods, sardines, oysters, clams, kale, turnip greens, mustard greens
Iron	:	Red meat, pork fish, poultry, tendrils, beans soy food, raisins
Magnesium	:	Whole-grains, nuts, leafy green vegetables, potatoes, beans, bananas, broccoli
Phosphorus	:	Dairy foods, meat, fish
Potassium melous,	:	Broccoli, potatoes (with skin) leafy green vegetables, citrus foods, bananas, dried fruit, peas, beans, apricots, mangoes
Zinc	:	Red meat, poultry, sea foods, soy foods, milk, wheat germ, whole-grains

*Fortified foods and beverages such as breakfast cereals, wheat flour (atta), bread, biscuits, fruit juices, milk and dairy products, sports drinks contain many of these vitamins and minerals and labels should be studied for information.

APPENDIX II

Percent of People with Micronutrient Intake Less Than 50 Per Cent of RDA

Nutrient	Children	Girls	Males	Females
	1-3 age	13-15 age	>18 age	>18 age
Iron	72	68	50	68
Vit. A	87	88	83	86
Riboflavin	70	68	55	48
Folic Acid	37	65	38	55

RDA is recommended daily allowance
Source: NMMB

APPENDIX III

Summary of The Studies Carried out at NIN.

S.No	Group	Phase	Weight (kg)	Fat (%)	BMR (kcal/d)	VO_2max l/min	ml ml.kg.m	EE Kcal/d	EE-Kcal kg/d
1.	Sr.Women Hockey	CP	51.1	16.3	1247	—	—	2810	55
2.	Jr.Men Hockey	CP-rest	57.6	7.6	1560	—	—	2825	49
3.	Sr. Women Track Athletes	Post-Com Rest phase	40.2	15.3	1100	—	—	1850	46
4.	Foot Ball	PP	57.1	11.0	1319	2.76	48.5	3150	55
5.	Sprinters	TP PP CP	61.4 61.1 62.9	9.9 9.8 9.6	1452 1500 1585	2.91 3.02 3.25	47.6 49.4 52.1	2630 2981 3410	43 49 54
6.	Middle Distance Runners	TP PP CP	50.3 51.9 52.8	9.5 9.5 9.9	1216 1299 1404	2.63 2.93 3.12	52.1 56.4 58.8	2360 2989 3483	47 58 66
7.	Long Distance Runners	TP PP CP	52.4 53.1 53.9	10.6 9.7 10.3	1282 1328 1423	2.69 2.84 3.12	51.2 53.6 57.9	2554 3064 3597	49 58 67
8.	Boxers	CP	68.3	15.4	1650	3.52	51.6	4424	65

Source: National Institute of Nutrition

APPENDIX IV

Energy Allowance Recommendations for Different Categories of Sports Events

Group	Type of Activity	**Average** Body. Wt (Kg)	**Kcal/Kg/Day**	**Total** (K.Cal/Day)
I.	Power events of super heavy category	**100+**	70	**7000+**
II.	Power events of higher weight category: **Heavy weight lifting, boxing, wrestling, Judo.** And Throwing events (hammer, shot-put, discus etc.)	**80-90**	**70**	**6000**
III.	Endurance events: Marathon, Long distance running, **Long distance Walking, Road cycling, Rowing, Middle &** Long distance swimming (200mt. And above.)	**65 (60-70)**	**80**	**5200**
IV.	Team events & Power events of Middle Weight Categories: Hockey, Foot ball, Volley ball, Basket ball, Tennis, Track Cycling, Javelin, Badminton, Hand ball, Jumpers, Sprint running And Swimming (below 200mt.), Water Polo Middle weight Categories of Power events like Boxing, Wrestling, Weight lifting, And Judo (60-80kg.)	**65 (60-70)**	**70**	**4500**
V.	Events of Light Weight Category: Gymnastics, Table Tennis and Power events of Lightweight category (60kg. Below) and Yachting	**60**	**60**	**3600**
VI.	Skill Games: Shooting, Archery and Equestrian	**60**	**50**	**3000**

Source: National Institute of Nutrition

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APPENDIX V

Energy Contribution from Various Food Stuffs in Diets of Different Groups

ã Food Stuff (g)	Group - I Diet - A	Group - II Diet - B	Group - III Diet - C	Group -IV Diet - D	Group - V Diet - E	Group - VI Diet - F
Cereals	890	730	630	550	400	350
Pulses	110	60	40	40	40	40
Green Leafy Veg	200	150	150	150	150	150 .
Other Vegetables	250	210	200	200	200	150
Roots & Tubers	180	160	150	150	150	125
Milk (ml)	750	750	750	750	750	600
Oil	75	60	50	50	50	50
Butter	30	25	25	25	20	15
Sugar	80	80	80	80	60	60
Jam	40	40	40	20	20	20
Meat	400	350	250	250	250	200
Eggs	200	150	150	100	50	50
Fruits	350	300	200	150	150	150
Calories (k.cal/day)	**7000**	**6155**	**5320**	**4560**	**3700**	**3000**
Protein (g)	**250**	**230**	**186**	**170**	**148**	**124**
Fat (g)	**192**	**164**	**164**	**155**	**125**	**100**
% Energy Contribution (Carbohydrate:Fat:Protein)	**61:25:14**	**54:31:15**	**58:28:14**	**54:31:15**	**54:30:16**	**54:30:16**
Body Weight (kg)	100	85	65	65	60	60
Energy (k.cal / day)	70	70	80	70	60	50
Protein (g / k.g / day)	2.5	2.7	2.9	2.6	2.5	2.1
Fat (g / k.g / day)	1.9	1.9	2.5	2.4	2.1	1.6
CHO (g / k.g / day)	10.9	9.8	11.9	9.5	8.3	6.7
CHO Energy	4272	3324	3086	2462	1998	1604
CHO (g)	1068	831	772	616	500	401

Source: National Institute of Nutrition

APPENDIX VI-A: (Diet-A:7000 K. cals)

Meal	Preparation	Raw weight
Bed Tea:	1 cup (with milk & 2tsp. sugar) Bisects (6 nos.)	120 ml 30g
Breakfast:	Bread 8 Slices Butter (3 Pck-10*3) Jam (5 tsp.) Eggs (4 nos.) Corn-flakes (6tbsp) Milk (with 2tsp. Sugar)	160g 30g 25g 200g 30g 220ml
Mid-Morning:	Lime Juice (with 3tsp sugar)	220ml
Lunch:	Rice Chapatis (6nos) Dal Vegetable curry(2 katori) Curd (1 cup) Fruit (2 nos.)	300g 180g 60g 300g 125g 200g
Evening: (4.00pm)	Biscuits (4 nos.) Tea (with milk & 2tsp sugar) Mutton Burger/non.veg.snack (3 nos.) For vegetarians: paneer burger, snack (2 nos.)	20g 120ml 150g 150g
Evening: (6.00pm)	Lime Juice (with 3tsp sugar)	220ml
Dinner:	Rice / Chapati Dal Vegetable curry(2 katori) Mutton Preparation (Chicken/ Mutton- Bone less) **For Vegetarians:** Soya Bean preparation(Nutri-nuggets) Cheese(2 piece) Dessert (1 serving) Curd (1 cup)	250g 50g 250g 250g 40g 50g 150g 125g
Bed Time:	Warm Milk (with 2tsp. Sugar) Fruit (1 no.)	250ml 150

Note: *75g. Of oil should be used for cooking. 125g. of vegetables in the form of onions, Tomatoes Etc. to be used in gravy preparations.*

Source: National Institute of Nutrition

APPENDIX VI-B: (DIET-B: 6000 K.cals)

Meal	Preparation	Raw weight
Bed Tea:	1 cup (with milk & 2tsp. sugar) Biscuits (4 nos.)	120 ml 20g
Breakfast:	Bread 8 Slices Butter (2 Pck-10*2) Jam (4 tsp.) Eggs (3 nos.) Corn-flakes (4tbsp) Milk (with 2tsp. Sugar)	160g 20g 20g 150g 20g 220ml
Mid-Morning:	Lime Juice (with 3tsp sugar)	220ml
Lunch:	Rice Chapatis (4nos) Dal Vegetable curry($1^1/_2$ katori) Curd (1 cup) Fruit (1-2 nos.)	250g 120g 60g 250g 125g 150g
Evening: (4.00pm)	Biscuits (4 nos.) Tea (with milk & 2tsp sugar) Mutton Burger/non.veg.snack (3 nos.) For vegetarians: paneer burger, snack (2 nos.)	20g 120ml 150g 150g
Evening: (6.00pm)	Lime Juice (with 3tsp sugar)	220ml
Dinner:	Rice Dal Vegetable curry($1^1/_2$ katori) Mutton Preparation (Chicken/ Mutton- Bone less) **For Vegetarians:** Soya Bean preparation(Nutri-nuggets) Cheese(2 piece) Dessert (1 serving)	200g 50g 200g 250g 40g 50g 150g
Bed Time:	Warm Milk (with 2tsp. Sugar) Fruit (1 no.)	250ml 150

Note: 75g. Of oil should be used for cooking. 125g. of vegetables in the form of onions, Tomatoes Etc. to be used in gravy preparations.

Source: National Institute of Nutrition

APPENDIX VI-C:(DIET-C: 5200 K.cals)

Meal	Preparation	Raw weight
Bed Tea:	1 cup (with milk & 2tsp. sugar) Biscuits (4-6 nos.)	120 ml 25g
Breakfast:	Bread 8 Slices Butter (2 Pck-10*2) Jam (4 tsp.) Eggs (2 nos.) Corn-flakes (4tbsp) Milk (with 2tsp. Sugar) Fruit (1no)	160g 20g 20g 150g 20g 220ml 150g
Mid-Morning:	Lime Juice (with 3tsp sugar)	220ml
Lunch:	Rice Chapatis (4nos) Dal Vegetable curry($1^1/_2$ katori) Curd (1 cup) Fruit (1-2 nos.)	200g 120g 40g 200g 125g 150g
Evening: (4.00pm)	Biscuits (4 nos.) Tea (with milk & 2tsp sugar)	20g 120ml
Evening: (6.00pm)	Lime Juice (with 3tsp sugar)	220ml
Dinner:	Rice Dal Vegetable curry($1^1/_2$ katori) Meat Preparation (Chicken/ Mutton- Bone less) **For Vegetarians:** Soya Bean preparation(Nutri-nuggets) Cheese(1 piece) Dessert (1 serving)	200g 30g 200g 250g 40g 50g 150g
Bed Time:	Warm Milk (with 2tsp. Sugar)	250ml

***Note**: 50g. Of oil should be used for cooking. 100g. of vegetables in the form of onions, Tomatoes Etc. to be used in gravy preparations Source: National Institute of Nutrition*

APPENDIX VI-D:(DIET-D: 4500 K.cals)

Meal	Preparation	Raw weight
Bed Tea:	1 cup (with milk & 2tsp. sugar) Biscuits (2 nos.)	120 ml 10g
Breakfast:	Bread 6 Slices Butter (2 Pck-10*2) Jam (4 tsp.) Eggs (2 nos.) Corn-flakes (4tbsp) Milk (with 2tsp. Sugar)	120g 20g 20g 100g 20g 220ml
Mid-Morning:	Lime Juice (with 3tsp sugar)	220ml
Lunch:	Rice Chapatis (2nos) Dal Vegetable curry($1^1/_2$ katori) Curd (1 cup) Fruit (1-2 nos.)	200g 60g 40g 200g 125g 150g
Evening: (4.00pm)	Biscuits (4 nos.) Tea (with milk & 2tsp sugar)	20g 120ml
Evening: (6.00pm)	Lime Juice (with 3tsp sugar)	220ml
Dinner:	Rice Dal Vegetable curry($1^1/_2$ katori) Meat Preparation (Chicken/ Mutton- Bone less) **For Vegetarians:** Soya Bean preparation(Nutri-nuggets) Cheese(1 piece) Dessert (1 serving)	200g 30g 200g 250g 30g 25g 150g
Bed Time:	Warm Milk (with 2tsp. Sugar)	250ml

Note: *50g. Of oil should be used for cooking. 100g. of vegetables in the form of onions, Tomatoes Etc. to be used in gravy preparations.*

Source: National Institute of Nutrition

APPENDIX VI--E:(DIET-E: 3600 K.cals)

Meal	Preparation	Raw weight
Bed Tea:	1 cup (with milk & 2tsp. sugar)	120 ml
Breakfast:	Bread 4 Slices Butter (2 Pck-10*2) Jam (4 tsp.) Eggs (1 nos.) Milk (with 2tsp. Sugar)	80g 20g 20g 50g 180ml
Mid-Morning:	Lime Juice (with 3tsp sugar)	220ml
Lunch:	Rice Chapatis (2nos) Dal Vegetable curry($1^1/_2$ katori) Curd (1 cup) Fruit (1-2 nos.)	150g 60g 30g 200g 125g 150g
Evening: (4.00pm)	Biscuits (2 nos.) Tea (with milk & 2tsp sugar)	10g 120ml
Evening: (6.00pm)	Lime Juice (with 3tsp sugar)	220ml
Dinner:	Rice Dal Vegetable curry($1^1/_2$ katori) Meat Preparation (Chicken/ Mutton- Bone less) **For Vegetarians:** Soya Bean preparation(Nutri-nuggets) Cheese(1 piece) Dessert (1 serving)	150g 25g 150g 150g 25g 20g 125g
Bed Time:	Warm Milk (with 2tsp. Sugar)	180ml

***Note**: 50g. Of oil should be used for cooking. 100g. of vegetables in the form of onions, Tomatoes Etc to be used in gravy preparations.*

Source: National Institute of Nutrition

APPENDIX VI-F:(DIET-F: 3000 K.cals)

Meal	Preparation	Raw weight
Bed Tea:	1 cup (with milk & 2tsp. sugar)	120 ml
Breakfast:	Bread 4 Slices Butter (1Pck) Jam (3 tsp.) Eggs (1 nos.) Milk (with 2tsp. Sugar)	80g 10g 15g 50g 180ml
Mid-Morning:	Lime Juice (with 2tsp sugar)	220ml
Lunch:	Rice Dal Vegetable curry($1^1/_2$ katori) Curd (1 cup) Fruit (1-2 nos.)	150g 30g 200g 125g 150g
Evening: (4.00pm)	Biscuits (2 nos.) Tea (with milk & 2tsp sugar)	10g 120ml
Evening: (6.00pm)	Lime Juice (with 3tsp sugar)	220ml
Dinner:	Rice Dal Vegetable curry($1^1/_2$ katori) Meat Preparation (Chicken/ Mutton- Bone less) **<u>For Vegetarians</u>:** Soya Bean preparation(Nutri-nuggets) Cheese(1 piece) Dessert (1 serving)	150g 25g 150g 100g 25g 20g 100g
Bed Time:	Warm Milk (with 2tsp. Sugar)	180ml

***Note**: 50g. Of oil should be used for cooking. 100g. of vegetables in the form of onions, Tomatoes Etc. to be used in gravy preparations.*

Source: National Institute of Nutrition

APPENDIX VII A

Pre Event Meals : 3-4 Hours Before Exercise

Following foods are suitable to eat 3-4 hours before exercise:

• Baked Potato + Cottage Cheese Filling + Glass of Milk
• Baked Beans on Toast
• Breakfast Cereals with Milk
• Bread Roll with Cheese / Meat Filling + Banana
• Fruit Salad with Fruit Flavored Yoghurt
• Pasta or Rice with a Sauce Based on Low Fat Ingredients (e.g. Tomato, Vegetables, Lean Meat)

APPENDIX VII-B

Pre Event Meals : 1-2 Hours Before Exercise

Following foods are suitable to eat 1-2 hours Before Exercise:

• Liquid Meal Supplement, Milk Shake or Fruit Smmothie, Sports Bar, Breakfast Cereals with Milk, Cereal Bars, Fruit Flavored Yoghurt, Fresh Fruits.

APPENDIX - VII C

Pre Event Meals : Less than 1 hour Before Exercise

Following foods are suitable to eat Less than 1 hour before exercise:

• Sports Drink, Carbohydrate Jell, Cordial Sports Bar, Jelly Lollies.

APPENDIX VIII

CALORIE RECKONER

OTHER VEGETABLES	Calories
Papaya, green-	
Papita	27
Parwar-parval	20
Peas- matar	93
Pepper, dry	104
Pepper, green	98
Plantain, green-kela	64
Pumpkin- kaddu	25
Tinda	21
Turnips	149
Vegetable marrow-	
Ghia	25
Water Chestnut, fresh	
Singhada	115

FRESH FRUITS	
Apple	56
Apricot	51
Banana	151
Bilimbi	21
Cape-goose berry-	
Rasbhari	51
Cherries	70
Dates	281
Figs	75
Guava	66
Grapes (blue)	45
Grape-fruit	32
Jamun	47
Lichis	61
Loquat	41
Mahua	76
Mango	50-80
Melon-white	21
Melon (water-melon)	16
Mulberry	51
Orange	51
Papaya	32
Peache	50
Pear	51
Pineapple	46
Plums	56
Pomegranate (red)	77
Sapota (Chicku)	94

CANNED FRUITS	
Fruit-cocktail (1/2 cup)	76
Peaches, 2 med. Halves	54
Pineapple, 2 slices	70

DRIED FRUITS	
Apricots	306
Dates, currants	317
Figs dried, 1 (20gms)	56
Melonseeds	607
Raisins	315

SALADS & SOUPS	
Beetroot	61
Cabbage	27
Carrot	48
Cucumber	17
Lettuce	21
Mint	48
Onion, (small)	59
Radish (White)	17
Radish (pink)	32
Tomato (ripe)	21
Brown mince soup-	
1 cup, (150ml)	115
Chicken-cream soup	
(150ml)	85
Clear vegetable soup	
(150ml)	11
Tomato cream soup	
(1 cup, 150ml)	85
Vegetable soup, (1 cup)	65

BISCUITS & CAKES	
Biscuit, salted 1	
(10gms)	15
Biscuit, sweet 1	
(4gm)	
Cream cracker, Nice	
Marie	24
Arrowroot	20
Cheese-ed-bits 10	
(15gm)	30
Coconut Macroon 1	
(11gm)	80
Cake, chocolate 1	
(45gm)	165
Cake fruit, 1 slice	
(30gm)	117
Cake, plain 1 slice (40gm)	146

SNACKS SAVOURIES	
Chakali (wheat flour)	550
Chat	474
Chewra (fried)	420
Dal Vadha 1 (30gms)	200
Dhokla	121
Gharvada	164
Godani Pongal	156
Kurdu	187
Murku	420
Mixed puff 1 (50gms)	200
Murukku	521
Namak para	581
Pakora	200
Potato chips	
10 pcs (20 gm) 2" dia.	110
Potato bachoni	166
Rava Adai	216
Samosa	256
Tapioca chips	570

SWEETS	
Badam Halwa	570
Balushahi	469
Burfi 1 pc (25gm)	100
Fruit jelly	75
Gujia	500
Gulab jamun 1 (25gm)	100
Imarti 1 (40gm)	200
Jalebi	421
Kalkal	750
Mysore Pak	757
Nankhatai	584
Pedha 1 pc (30gm)	87
Pinni	490
Rasgulla 1 (70gm)	100
Shakarpara	570
Sohan Halwa	400
Suji Halwa	176
Sweet appam	250
Sweet chikki	194
Vella Adai	221

BEVERAGES: SOFT & ALCOHOLIC	
Apple juice/Cider 100ml	95
Coconut water, 100ml	50
Coke 1 bottle	80
Coffee (with toned milk,	
no sugar)	25
Gingerale 1 bottle	60
Grape Fruit juice 100ml	65
Limca 1 bottle	50
Orange juice 100ml	95
Tea (with toned milk,	
no sugar)	21
tomato juice 100ml	45
Beer 340ml	121
Brandy 30ml	77
Gin (Dry) 41ml	105
Rum, Whisky 41ml	105
Sherry 60ml	84
Sweet wine (Port)	
100ml	160

MISCELLANEOUS	
Horlicks 10gms	
(1 teaspoon)	41
Ovaltine/Bournvita	
10gms (1 teaspoon)	78
Papad 1 (1 ¼" dia.)	
(a) Grilled	25
(b) Fried	47
Pickles 1 pc (10gm)	
(a) Mango sour with	
1 teaspoon spices	66
(b) Vegetable sweet	40
Tamarind pulp	281

Source :
Boehringer Mannheim India Ltd.

APPENDIX IX

List of Abbreviations

NIN	National Institute of Nutrition
ILSI-India	International Life Sciences Institute - India
Kcal	Kilocalories
TP	Transition Phase
CP	Competition Phase
PP	Pre-competition Phase
BMR	Basal Metabolic Rate
SD	Sprint Distance
MD	Middle Distance
LD	Long Distance
SO	Slow Oxidative
FOG	Fast Oxidative Glycolytic
FG	Fast Glycolytic
ATP	Adinosinetryphosphate
ADP	Adinosinediphosphate
FFA	Free Fatty Acids
CP	Creatine Phosphate
RDA	Recommended Daily Allowance
FAO	Food and Agriculture Organization
WHO	World Health Organization
NNMB	National Nutrition Monitoring Bureau
DIPAS	Defense Institute of Physiology and Allied Sciences
SAI	Sports Authority of India
NIS	National Institute of Sports
TDEE	Total Daily Energy Expenditure
LDL	Low Density Lipoprotein
HDL	High Density Lipoprotein
LBM	Lean Body Mass
TE	Treadmill Exercise
CE	Cycle Ergometry
GXT	Graded Exercise Tests
TAP	Time-Allocation Pattern
DXT	Dual Exercise Test

About ILSI / ILSI-India

The International Life Sciences Institute (ILSI) is a non profit, worldwide foundation established in 1978 to advance understand of scientific issues relating to nutrition, food and water safety, toxicology, risk assessment, and environment by bringing together scientists from academia, Government, industry, and the public sector to solve problems with broad implication for the well being of the general public. Headquartered in Washington DC, ILSI has 15 regional / country branches across the globe. ILSI has special consultative status with the Food and Agriculture Organization of United Nations and works on various collaborative programs. It is also affiliated to World Health Organization as a non-governmental organization. ILSI receives financial support from industry, Government and foundations.

ILSI-India works on issues relating to food and water safety, nutrition, risk assessment, biotechnology and environment. It works very closely with industry, R & D organizations, government departments, Ministry of Food Processing Industries, Ministry of Health, Department of Biotechnology, Ministry of Science and Technology and international organizations like FAO, WHO, WFP and UNICEF. ILSI-India has acted as a conduit for the latest information about scientific research worldwide on food safety and nutrition issues. ILSI-India has contributed significantly to capacity building through its conferences, workshops and training programs in India and other countries in the South Asian Region.

National Institute of Nutrition (NIN)

The National Institute of Nutrition (NIN), Hyderabad is one of the premier permanent research institutes of the Indian Council of Medical Research (ICMR), an autonomous body under the aegis of the Ministry of Health and Family Welfare, Government of India. The history of this Institute spans over eight decades. NIN's objectives include: identification of various dietary and nutrition problems prevalent among different segments of the population, monitoring diet and nutrition situation of the country; evolving effective methods of management and prevention of nutritional problems keeping the existing economic, social and administrative set-up in view, conducting operational research connected with planning and implementation of national nutrition programs; dovetailing nutrition research with other health program of Government; developing a band of young scientists, teachers in medical schools and health workers, well trained in nutrition; disseminating nutrition information for institutional and community benefit and advising Governments and other organization on issues relating to nutrition.

Sports Authority of India (SAI)

The Sports Authority of India (SAI) was established by the Government of India in March 1984 with the twin objectives of broad-basing of sports and spotting / nurturing of talented children in different age groups for achieving excellence at the national and international level by providing them with requisite infrastructure, equipments, coaching facilities, scientific back up, nutritional diet, competitive exposure and other facilities.

SAI has six regional Centres at Bangalore, Gandhi Nagar, Kolkata, Chandigarh, Bhopal, and Imphal and Sub-Centres at Guwahati, Hazaribagh, Nagerkoil, and Lucknow. Sports science and sports medicine facilities have been developed at the Centres at Delhi, Patiala, Bangalore and Kolkata. SAI also has two Academic Wings-one for training of coaches and research and development in sports at the Netaji Subash National Institute of Sports, Patiala and other for physical education at the Laxmibhai National College of Physical Education, Thiruvananthapuram.

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