CHAPTER ONE

INTRODUCTION TO SPORT NUTRITION

1.1. Food, Diet and Nutrition

What is food?

Food is edible or potable substance (usually of animal or plant origin), consisting of nourishing and nutritive components such as carbohydrates, fats, proteins, essential mineral and vitamins, which (when ingested and assimilated through digestion) sustains life, generates energy, and provides growth, maintenance, and health of the body. Food (which really includes many types of drinks too like milk shakes and cola but not water) is made up of nutrients. These are the things which give you energy or help build up your body as you grow.

What does "diet" mean?

Nutritionists use "diet" to mean all the food you eat. Diet is not just menus for a day or week, but your usual food choices over time. Many other people use "diet" to describe a plan for weight loss or a specific prescription Diets comprises those foods that certain lives on from day to day. Generally, humans are generally omnivores or vegetarians. Omnivores are people whose diets contain plant and animal food sources whereas; vegetarians survive fruit and veggies only.

Diet: - is any food and drinks normally taken by somebody or a group or even a prescribed course of what is to get eaten and what's not. This definition takes into account the belief that whatever you drink e; Milk, water, beer, whisky etc is part of your respective diet. You will find there's saying that, you are your food intake, which means that your diet can greatly assist to calculate what will you become from now on since some diets confers longevity and some kill you fast.

Problems with diets

Diets include some problems especially bad diets. Each time a person becomes addicted to particular unhealthy diet, there's predisposition to many diseases mainly because of the diet. The main topics healthy dieting is now an increasingly popular one around the world and a lot more people are realizing the need to create a well-engineered diet deemed fit on their own. Higher fat diet could potentially cause stroke, hypertension, heart disease, diabetes, obesity and low self-confidence.

Is there a best diet plan?

Generally whenever we talk about diets that is good for health, what quickly one thinks of is a balanced diet. But a diet should not request have to be balanced but healthy. So a healthy diet is a lot more desirable for anyone planning to loss drop some pounds. The best diet plan for weight loss includes a good amount of proteins, small amounts of carbohydrates and an insignificant quantity of fat. Some individuals prefer to avoid unhealthy fats entirely an internet to lose weight. It will also have a rich quantity of vitamins, minerals and also other essential nutrients to ensure a sound body and vitality.

1.2. What is Nutrition?

- Utilization of food to grow, repair and maintain our bodies;
- Getting the right amount of nutrients from healthy foods in the right combinations; making smart choices about the foods you eat;
- Proper nutrition helps you develop and maintain good health;

Simply said, Nutrition is the study of food at work in our bodies, our source for energy, and the medium for which our nutrients can function. Think of nutrition as the building blocks of life.

Malnutrition

Ingesting too much or too little of a nutrient can interfere with health and wellbeing. There is a beneficial range of intake for any nutrient; an intake below or above that range is incompatible with optimal health. Thus, malnutrition (poor nutrition) occurs when body cells receive too much or too little of one or more nutrients. For example, a single food diet, such as a grapefruit diet to lose weight, will result in malnutrition if followed for an extended period.

Under-nutrition

Malnutrition includes under-nutrition, the result of a deficiency of one or more nutrients. Under-nutrition may be related to:

- An individual's inability to obtain foods that contain the essential nutrients
- An individual failure to consume essential nutrients the body's inability to use the nutrients in food
- Disease conditions that increase the body's need for nutrients

A disease process is that causes nutrients to be excreted too rapidly from the body. Under-nutrition occurs in many different circumstances. For example, stress from trauma, surgery or burns frequently produce a state of under-nutrition. People exposed to such sever and prolonged stressors may be undernourished even if they consume an apparently normal diet. Prolonged physical stress causes the body to break down internal protein stores and protein is excreted as a result. Groups especially vulnerable to under-nutrition are children, pregnant women, and elderly people.

Over-nutrition

Over-nutrition, which is an excessive intake of nutrients, is another form of malnutrition. It is often resulted from the use of self-prescribed over-the counter vitamin and mineral supplements. For example, when ingested in very high does once or habitually, performed vitamin A can cause headache, vomiting bone abnormalities, and liver damage. Vitamin D toxicity can lead to the deposit of calcium in soft tissue and irreversible kidney and cardiovascular damage.

1.3. Concepts of Sports Nutrition

The name "Sports Nutrition" is social misnomer, because it implies a special kind of nutrition only for people who play sports. Granted, anyone engaged in sport is a candidate for such a reference but 'sports' in this context is generic and much broader in its definition. It's much like how many of us refer to natural health products (NHPs) or dietary supplements as "vitamins". For example, "Johnny, have you taken your vitamins today?" Technically, minerals & amino acids are not vitamins, neither are gingko or grape seed extract, but for ease of reference and understanding, the term "vitamin" is commonly used as a general label. The same is also true regarding Sports Nutrition. It encompasses an extremely wide range of potential candidates, including athletes, weekend warriors, gym rats, fitness buffs, diehard aerobic queens and sport fanatics. It includes anyone engaged in physical activity.

In fact, if you train and eat food, you're engaged in sports nutrition. The Koran refers to life itself as a Sport, so viewed in this context; everyone's a candidate by default. Sports Nutrition product suppliers often create advertising strategies designed to reach a very specific and narrow range of audience, such as cyclists, skiers or bodybuilders. Performance benefits attract athletes and anything to do with muscle or 'weight loss' creates interest. So the perceived specificity of the term can also be very useful from a marketing point of view, but remember, sports nutrition is not just for people who play hockey, football or soccer. If you look up "sport" in Webster's New World dictionary, it's first defined as "any activity or experience that provides enjoyment or recreation" and then goes on to include activity by way of bodily exertion. It also mentions both fun & play as vital components.

Sports Nutrition' is an art and a science. The **ART** consists of nourishing an active body with high quality food and natural health products in a skillful, safe and consistent manner. This pertains not only to what we eat, but also when, where and how. Whole food and NHPs are administered with reference to dozens of variables including (but not limited to): Food Quality and Quantity, Macronutrient Percentage, Enzyme Activity, Somato-Type, Athletic Objective, Blood Type, ethnic Origin, Training Volume, Intensity and Frequency, Specificity of Sport Current Health Status, Body Composition and Etc.

The science of sports nutrition helps all of us to understand the "how" and the "why". Through observation, research and repeated experiment, experts in the field investigate the effect of controlled exercise, food and natural health products on the health, recovery and performance of athletes. To be successful in the world of sport, fitness and health, and to remain well and injury free, one must apply the art as a derivative of sound science. This is the essence of the natural health food & fitness movement. Both are inseparably and equally essential.

Sports Nutrition recognizes textbook nutrient deficiencies, but also explores the possibility of utilizing whole food and natural health products such as creatine or glutamine to obtain higher levels of performance and quality of living. ***"Sports Nutrition is for anyone who is ultimately concerned about health and fitness and their ability to perform with excellence in life!"*** From a biological point of view, the 'prime directive' and function of nutrition is to supply a living organism with the energy and micronutrients it requires for nourishment, optimum function and maintenance of life. Taste, texture and culinary pleasure are secondary to provision of such nutrients in relation to biological demand.

The function of food is to sustain life (not simply to gratify sensory pleasure). "No matter what one's fitness or exercise goals, good nutrition can help improve exercise performance, decrease recovery time from strenuous exercise, prevent exercise injuries due to fatigue, provide the fuel required during times of high intensity training and control weight. Combining good nutrition with exercise can also help reduce the risk of numerous chronic diseases such as diabetes, cardiovascular disease, hypertension, obesity, osteoporosis, and some cancer; moreover, physicians often recommend nutrition and exercise to treat individuals who already have these diseases. Learning how nutrition and exercise work together for optimal health is essential for health, nutrition, or fitness professionals who must teach the public how to maintain good health and reduce risks of chronic disease".

1.4. Balanced Diet

A balanced diet maintains proper energy and nutrient balance. It does not have to be expensive when you follow some of the ideas below.

Guidelines for a Balanced Diet

- Eats lots of different kinds of food – vegetables, fruits, fish, meats, dairy produce and grains
- Eat fresh food rather than ready prepared, canned or frozen foods
- Eat a high proportion of complex carbohydrate rich foods Grill, steam or bake foods.
- Avoid boiling or frying Avoid fatty meals and sweet and salty snacks
- Check fiber intake by eating whole grain breads, cereals, pastas Eat brown rice instead of white rice Flavor food with herbs and spices rather than salt
- Drink water and fruit juices often.

1.5. Nutrition and Sports Performance

Athletes Have Special Needs

- Require More Nutrients
- increase in Protein
- Increase in Carbohydrates
- Increase in Vitamins and Minerals

Benefits of Proper Nutrition

- Decreased time of recovery
- Increased energy
- Decreased loss of muscle tissue
- Improved-performance
- Increased stamina
- Decreased percent body fat
- Injury prevention
- Improved health

Sport-specific nutrition

Aerobic Sports: (football, baseball, softball, volleyball, tennis, track & field athletics).

- Explosive strength is required /long periods of rest.
- ATP-CP immediate energy source.
- High protein requirements for FT-muscle fiber.
- Constant supply of carbohydrates to refuel body's glycogen stores.

Sports nutrition is the practical science of hydrating and fueling before, during, and after exercise.

Executed properly, sports nutrition can help promote optimal training and performance.

1.6. Principles of Sports Nutrition

. Stay hydrated.

. Provide fuel for your muscles.

. Recovery after Promote optimal exercise

Apply these principles correctly and you can consistently maximize the gains from your training and compete at your best.

1. **Hydration**

During exercise, you lose fluid and electrolytes as you sweat:

- The key electrolyte is sodium.
- If you don't replace both fluid and sodium during exercise, you can become dehydrated.

The single largest contributor to fatigue during exercise is dehydration caused by fluid and sodium losses:

Inadequate fluid and sodium make your heart work harder and make exercise much more difficult. Dehydration also impairs concentration and the ability to make tactical decisions. Complicating matters is that thirst alone is not a good indicator of your hydration needs during exercise.

Drink before you are thirsty

Losing over 2% of your body weight due to fluid loss during exercise means you are dehydrated and your performance has already been hampered**:**

- ✓ A 2% loss is just 3 lbs for a 150-lb athlete.
- ✓ It is common to lose this much fluid, or more, during a workout or competition.

Consuming too much fluid during exercise leads to over hydration*,* which also impairs performance and can have serious health consequences.

Stay within your *hydration zone* during exercise:

- ✓ Avoided gaining weight during exercise due to over consuming fluid.
- ✓ Do not lose any more than 2 % of your body weight due to fluid lose.

Fortunately, dehydration and over hydration can be avoided or minimized by sticking to a disciplined hydration plan.

2. **Fueling**

- ✓ Carbohydrates are the primary fuel for most types of exercise.
- ✓ 60–90 minutes of endurance training or a few hours in the weight room can seriously deplete carbohydrate muscle fuel stores.
- ✓ If your diet is too low in crabs, your workouts and performance will suffer.

- ✓ Starting exercise with full carbohydrate stores can delay the onset of fatigue and help you train and compete more effectively.
  - ✓ The more intense your training or competition, the higher your daily carbohydrate intake should be in the suggested range of 2.3–4.5 grams of crabs per lb (5–10 g/kg) body weight daily.

There are two forms of carbohydrate in your body:

Glucose, which circulates in the bloodstream

Glycogen, which is bundles of glucose stored in the liver and muscles

When you're fully loaded with crabs, you have:

- About 40 calories of glucose in the bloodstream
- About 1,900 calories stored as glycogen in the muscle, plus liver glycogen
- When you run out of muscle glycogen stores, you rely on your small reserves of liver glycogen to maintain blood glucose levels.
- After liver glycogen stores are used up, blood sugar level drops and you are forced to either slow way down or stop.
- In some sports, this is called "hitting the wall" or "bonking."

Avoid running out of muscle fuel during workouts and competitions:

- Start training sessions and competitions fully fueled
- Refuel as needed during exercise
- Replenish glycogen stores after exercise

Restricted-carb diets are not appropriate for athletes!

3. **Recovery**

- Workouts and competitions deplete your glycogen stores.
- Muscle tissue gets damaged as you train and compete, and requires repair.
- Your muscles also are being stimulated to adapt to your training workload.
- Recovery involves reloading carbohydrate fuel stores, repairing and building new musle tissue and rehydrating
- Recovery doesn't start after exercise until you provide your body with the nutritional components that it needs: Carbohydrates
- Protein
- Fluids and sodium

Promote rapid recovery after exercise—as soon as possible after training or competing **(Within 30–60 minutes)**, consume:

- ➢ **Carbohydrates** for glycogen restoration

- **Protein** for repairing damaged muscle tissue and for building new muscle tissue as an adaptation to training workload
- **Fluids** and **sodium** for rehydration

Hydration to Recovery

Putting the principles of sports nutrition into practice:

- Start exercise fully hydrated and fueled.
- Stay in your hydration zone and know what to hydrate with during exercise.
- Refuel as needed during exercise.
- Promote full recovery after exercise.
- Practice your regimen during training.

Start Exercise Fully Hydrated and Fueled

- **Start exercise fully hydrated** by drinking 14–20 fl oz (400–600 ml) of water or sports drink 2–3 hours before training or competing. Keep hydrating as needed during warm-ups.
- **Top off muscle energy stores** by consuming a carb based meal 2–4 hours before exercise. Choose familiar carb based foods and beverages. Avoid slow-to-digest fatty and high-fiber foods prior to exercise.
- **Eat a carb-based snack** with 40–60 grams of carbs 30–60 minutes before exercise, along with fluids (see appendix for examples)

Refuel as Needed During Exercise

Carb Refueling Recommendations	
Exercise lasting less than 1 hour	Carbohydrate intake during exercise is not required to fuel your Performance However, a sports drink with carbs and sodium can help you hydrate More effectively.
Exercise lasting 1–2 hours	Consume 30–60 g of carbs during each hour of exercise, to help boost performance and extend endurance
Intense training lasting longer than 2–3 hours	Consume 45–90 g of a 2:1 blend of glucose and fructose per hour of exercise, to increase energy delivery to muscles and extend endurance.

Promote Full Recovery: After Exercise

Carbohydrates

To speed glycogen restoration after strenuous exercise:

- Aim for carbs in the amount of 0.5 grams per lb (1.1 grams per kg) body weight within 30 minutes of finishing exercise.
- For a 150-lb (68-kg) athlete, that equates to 75 grams of carbohydrates right after exercise.
- Repeat this within 2 hours after exercise, or eat a carb-based meal.
- For heavy training, repeat this hourly for the first 3 hours after exercise, or eat carb-based meals and snacks.
- Simple carbs right after exercise are more effective at speeding glycogen restoration.

Protein

- Focus on timing your protein intake in relation to workouts and meeting your total

daily protein needs:

- After exercise/training:
- ✓ Aim for 15–25 grams of protein within 30–60 minutes
- ✓ Total daily need for protein:0.55–0.77 grams per lb (1.2–1.7 g/kg) body weight (teens might require more)
- ✓ About 82–116 grams of protein per day for a 150-lb athlete

Fluids and Sodium

Even if you are diligent in your hydration efforts during exercise, you might lose more fluids **and sodium than you take in:**

- Weigh yourself before and after exercise to gauge your net loss of fluids.
- Replace lost fluids by gradually consuming 16–24 fl oz of a sports drink, recovery beverage, or water for every lb of weight lost (1,000–1,500 ml/kg body weight lost).
- Rehydration will be more effective when sodium is included with the fluids and food that you consume as you recover.

To apply sports nutrition principles correctly, practice them during training:

It is only through a system of trial and error during training that you can develop your own Personalized sports nutrition plan

- Practice your sports nutrition regimen during training. Don't try anything new on race or game day.

Aim for a well-balanced diet:

- ❖ Consume a variety of whole grains, vegetables, and fruits; lean protein sources; and healthy fats.

Focus on carbs

- ❖ Carbohydrates are the major muscle fuel source and should be the primary focus of your diet. Fill ¾ of your plate with carbohydrate -based foods such as fruit, cereals, pasta, bread, potatoes, and vegetables.

Drink up early:

- ❖ Fill the other ¼ of your plate with lean protein foods such as fish, poultry, lean beef, low-fat dairy products, and beans.

Drink up early: Have a large glass of water every morning when you wake up.

Keep up your energy levels:

- ❖ Eat 5–6 meals per day

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Examples of carbohydrate-based pre-exercise meals	
(2–4 hours before exercise) **Breakfast** • Cold or hot cereal, fruit, and low-fat or nonfat milk • French toast or pancakes with maple syrup • English muffin with jam and peanut butter, banana, and fruit juice	Lunch or Dinner • Pasta with tomato sauce, french bread, steamed vegetables, low fat/non fat milk, pudding and canned fruit. • Grilled chicken sandwich, paked potato with low fat sauce cream or salsa and low fat frozen yogurt • Thick crust cheese pizza, low fat gelato and canned peaches • Packed or grilled chicken, steamed rice, green beans, low fat frozen yogurt and fruit juice

Summary

Nutrition is the process of nourishing or being nourished, especially the process by which a living organism assimilates food and uses it for growth and replacement of tissues. Nutrients are substances those are essential to life which must be supplied by food. Sports Nutrition' is an art and a science. The art consists of nourishing an active body with high quality food and natural health products in a skillful, safe and consistent manner. The science of sports nutrition helps all of us to understand the "how" and the "why". Through observation, research and repeated experiment, experts in the field investigate the effect of controlled exercise, food and natural health products on the health, recovery and performance of athletes.

CHAPTER TWO

2. BASIC NUTRIENTS

INTRODUCTION

Health is very dependent upon the foods and fluids consumed. Poor eating habits have been associated with hyperactivity in children, physical fatigue, mental fatigue, depression, stunted growth, and numerous other problems. Five of the 10 leading causes of death have been associated with diet: 1) heart disease, 2) cancer, 3) atherosclerosis, 4) stroke, and 5) type 2 diabetes. The body is composed of the elements outlined in the table below. These elements are constantly being used to provide energy for the body, to build new cells, to repair old cells, and to regulate the various body processes. Since the body is unable to absorb these elements through the skin, they must be gained through daily consumption of foods and fluids.

Nutrients are chemical parts of food and liquids that have specific functions in the body. The two overall functions of nutrients are

1) To provide essential elements the body needs to sustain life and
2) To provide energy for the body. The essential elements needed for health fitness are found in six basic nutrients.

Percentage of the Basic Elements of the Body

Non-Metallic Elements		**Metallic Elements**	
Element	*Percent*	***Element***	*Percent*
Oxygen	65	Calcium	1
Carbon	18	Phosphorus	1
Hydrogen	10	Sodium	1
Nitrogen	3	Potassium, chlorine, sulfur, magnesium and 15+ others	1
Total	96	Total	4

2.1. Macro-Nutrients: - (Carbohydrate, fat and protein)

Nutrients are the chemical substance found in the food that we eat. An important aspect of nutrition is the daily intake of nutrients.

Nutrients consist of various chemical substances in the food that makes up each person's diet. Many nutrients are essential for life and an adequate amount of nutrients in the diet is necessary for providing energy, building and maintaining body organs and for various metabolic processes. People depend on nutrients in their diet because the human body is not able to produce many of these nutrients or it cannot produce them in adequate amounts.

- Nutrients are essential to the human diet if they meet two characteristics. First, omitting the nutrient from the diet leads to a nutritional deficiency and a decline in some aspect of health.
- Second, if the omitted nutrient is put back into the diet, the symptoms of nutritional deficiency will decline and the individual will return to normal, barring any permanent damage caused by its absence.

The Three Functions of Nutrients are:

- **Provide Energy:-** Carbohydrates Proteins and fats
- **Regulate body functions:** - Proteins, fats
- **Promote growth and development:** - proteins, fats, vitamins, minerals and water.

Major classifications of nutrients, which include:-

- **Carbohydrates**
- **Fats**
- **Proteins**
- **Vitamins**
- **Minerals**
-

Note: Fiber is an addition requirement, as it aids the function of the digestive tract and Protects against many diseases

These nutrients can be categorized in to two groups.

Macro nutrients: - are nutrients they have energies and we need large quantity:-

1. **Carbohydrates.**
2. **Proteins.**
3. **Fats**

Micro nutrients: - are nutrients they have no energies and we need in small quantity:-

1. **Vitamins.**
2. **Minerals.**

To have enough energy for exercise and for life an adequate number of calories must be consumed.

The amount of calories needed depends on many different factors such as:-

- Age
- Sex
- Height
- Weight
- Muscle mass and
- Fat mass

Too few calories can negatively affect workouts and energy levels, as well as increasing the risk of injury. It is important to nourish the body after several hours with no food (such as during sleep), so breakfast is an important part of adequate calorie intake. The energy value of a food is computed by multiplying the number of grams of each energy nutrient in a serving of food by the caloric values per gram of carbohydrate, Protein, and fat as follows: for example, if a food has 10 grams of carbohydrates, 5 grams of protein, and 4 grams of fat, the caloric value is calculated as follows:

	Grams x Kcal	Total
Carbohydrate	10 x 4	= 40
Protein	5 x 4	= 20
Fat	4 x 9	= 36
	Total	= 96 calories

2.1.1 Carbohydrates

The primary function of carbohydrates is to provide all the cells of the body with energy. While most cells use a combination of both fats and carbohydrates for energy, the central nervous system (i.e. brain and nerve tissue) uses almost exclusively carbohydrates for energy. In activities of short duration requiring high energy, such as in sprinting and strength training, skeletal muscles use carbohydrates extensively for energy since fat metabolism is a slower energy producing process requiring oxygen.

Carbohydrates must be present in the diet for fats to be completely utilized for energy. If a diet is low in carbohydrates, then proteins from the skeletal muscles will be broken down and used in place of carbohydrates to meet this need. This procedure of catabolizing muscle tissue will cause problems in the body. On the other hand, excess carbohydrate consumption will cause this nutrient to be converted into fat and stored.

When carbohydrates are eaten, enzymes in the mouth, stomach, and small intestine begin to break the carbohydrates down into their simplest form (i.e. sugar). After this process has been accomplished in the small intestine, the sugar can pass through the intestinal wall and is absorbed into the blood stream. Once in the blood it is transported to the liver for conversion into glucose and then released back into the blood stream to be transported to body cells for energy. For glucose to enter most cells in the body insulin is required. Insulin is a hormone secreted by special cells in the pancreas and functions to transport the glucose out of the blood and into the cells. If the cells requirement for energy is low, then the glucose is changed into fat and stored in adiposities.

Types of Carbohydrates: - There are two basic types of carbohydrates:

1) Simple, which is mainly monosaccharide's, and disaccharides and

2) Complex or polysaccharides. Simple carbohydrates consist of sugars, (see the next table) and complex carbohydrates consist of starch and cellulose (fiber).

In processed foods, simple carbohydrates go under the names of brown sugar, honey, corn syrup, laevulose and dextrose. Regardless of the name, the body handles them all as sugars and must convert each of them into the usable form called glucose. A complex carbohydrate is composed of many sugars (50 to over 1000) combined together to form a complex molecule. Complex carbohydrates are primarily found in vegetables, grains, seeds, and fruits. Of the carbohydrates in the American diet, approximately half come from starches and half from sugars. Over the last few years, a new system for classifying carbohydrates has been developed; and is known as the glycolic index (see the next table).

The glycolic index is a ranking of carbohydrates based on their immediate effect on blood glucose levels. Carbohydrates that digest quickly cause a fast and sharp elevation in blood glucose level are given a high index ranking. Carbohydrates that digest slowly, releasing glucose gradually into the blood over a long period of time are considered a low glycolic food. High glycolic foods can trigger excessive insulin release due to the rapid increase of blood glucose level.

High insulin causes the liver to produce triglycerides and very low-density lipoproteins and releases them into the blood. Because of this, high glycolic foods can accelerate atherosclerosis (Chapter 4) making it a contributing factor in cardiovascular disease. In addition, the excess insulin will transport too much glucose out of the blood and into the cells causing low glucose levels (hypoglycemia) leading to weakness and hunger. The person then eats again, when it is really not necessary, demonstrating how high glycolic foods lead to a craving for more sugar.

The Six Common Simple Carbohydrate Types

No	Types	Source
1	Sucrose (table sugar)	Sugar beets and sugar cane
2	Fructose	Fruits and honey
3	Galactose	Milk
4	Lactose	Milk
5	Maltose	Grains and Cereals
6	Glucose	Fruits, corn syrup, and honey

Sample of High Glycemic and Low Glycemic Foods

High Glycemic Foods	Low Glycemic Foods
- Sugar - Potatoes - Bananas - White Bread - White Rice - Sodas - Fruit Juice	- Legumes - Whole Fruits - Whole Wheat - Brown Rice - Beans - Nuts - Leafy Vegetables

Over a period of years, the up-and-down effect of high blood glucose and high insulin levels followed by low blood glucose and low insulin can cause the cell to become resistive to insulin. Also, the insulin generating cells of the pancreas can become over-worked and slow their production of insulin. In time the blood glucose level remains elevated and a condition of diabetes develops. Most type 2 diabetes (Chapter 4) is due to this factor and is caused in part by the person's dietary habits, over fatness, and lack of exercise. When the diet contains excessive amounts of refined simple carbohydrates (sugar) found in soft drinks, bakery goods, and similar products; the body is being robbed of important nutrients. Table sugar is called "empty calories" because it contains no vitamins, minerals, or fiber. Also refined sugar sticks to the teeth and, with the bacteria present in the mouth, causes tooth decay (dental caries).

2.1.2 Fiber

Fiber is a type of complex carbohydrate of which cellulose is the most common form and is found primarily in fruits, vegetables, and grains. Since the body does not possess the enzymes necessary to break down fiber, it has no caloric value, and it passes through the small and large intestine relatively unchanged.

Function of Fiber - Although several specific purposes of fiber have been established, much is yet to be learned about its importance in the diet. Fiber promotes regular bowel (movements by absorbing water in the large intestine making the stools soft and large. Thus, elimination from the body is easily preformed with no straining or pushing, with a high fiber diet, constipation is rare and so are hemorrhoids.

High-fiber diets also quicken the transit time of food from intake to elimination Waste products of metabolism stay in the large intestine three times longer with low fiber diet. This allows the waste products some of which may consist of toxic chemicals and carcinogenic agents (i.e. cancer causing), a longer time to irritate the large intestine. This may be a strong factor in diverticulosis, colitis, and possibly colon cancer. Authorities recommend one to two bowel movements a day. Lack of fiber in the diet has also been associated with high blood cholesterol, appendicitis, gallbladder diseases, diabetes, and obesity. Fiber is absolutely an essential part of a healthful diet, not so much for what it does but for what it prevents.

Sources of Fiber - The amount of fiber required each day in the diet is one gram per 100 calories (20 - 35 grams). A typical American eats 14 to 15 grams daily, but vegetarians eat as much as 30 to 40 grams. Most current authorities recommend a safe amount of fiber of at least 25 grams per day. If a person does not normally have one to two bowel movements per day with soft stools, chances are there is not enough fiber in the diet. Like any nutrient, too much of a good thing can lead to problems. Excess fiber in the diet can lead to diarrhea, gas, and cause dehydration and mineral loss. The sources of fiber should vary (see the next table). Bran found in grain serves as one of the best sources of fiber. However, if the grain has been refined, the bran is lost and the fiber is gone. During the refining process most of the vitamins, minerals, and fiber is lost. After a food is refined, some of the vitamins and minerals are restored (enriched); and occasionally additional vitamins are added (fortified), but the fiber is still absent. Therefore, unrefined grains are best in order to receive the fiber they possess. While bran from grains is a good fiber source, at least half the fiber should come from vegetables and fruits. Cooking vegetables and fruits causes them to lose some of their fiber. Therefore, people should eat raw vegetables and fruits as much as possible.

Fiber Content in Selected Fruits, Vegetables, and Grains

Food	Serving	Fiber Grams
3 Broccli	1 medium stalk	6
3 Apple	1 medium	5
3 Almonds	¼ cup	5
3 Cabbage	½ cup	4
3 Peas	½ cup	3
3 Potato	1 medium	3
3 100 % whole wheat bread	2 slices	2
3 Banana	1 medium	2
3 Orange	1 medium	2
3 Strawberries	½ cup	1
3 Carrots	¾ cup	1

Fiber amounts in selected Breakfast cereals

Cereal (1 Serving	TotalCHO (grams)	Starch (grams)	Sugar (grams	Fiber (grams)
TM All Bran	21	7	5	9
TM Raisin Bran	31	11	14	6
TM 40% Bran Flakes	23	13	5	5
T Multi Bran Chex	25	15	6	4
TM Cracklin Bran	21	10	7	4
TM Shreded Wheat	19	16	0	3
TM Grape Nuts	23	17	3	3
TM Cheerios	20	19	1	2
TM Total	23	18	5	2
TM Special K	20	16	3	1
TM Special Loops	25	12	13	0
TM Apple Jacks	26	12	14	0

Breakfast cereals are an excellent source of fiber if property selected the above table lists, the breakdown of carbohydrates in selected high-fiber cereals. A breakfast of Corn Bran, Multi Bran Chex, or 40% Bran Flakes topped with strawberries or a banana can start the day off with a low glycemic index and high fiber meal.

They are composed of the elements **carbon (C), hydrogen (H) and oxygen (O). Or** It is a composed of carbon a tom and water (CH2O) n. Carbohydrates are the major source of energy for the body.

Through the bonding of these elements carbohydrates provide energy for the body in the form of kilocalories (kcal) with an average of 4 kcal per gram (kcal/g) of carbohydrates**.**

Carbohydrates made up of sugar and it is classified in to:-

A. **Smallest carbohydrates**
B. **Complex carbohydrates**

A. Smallest carbohydrates

The smallest carbohydrates are the simple sugars that are made up of one sugar unit two sugar units. This is

- **Monosaccharaides**
- **Disaccharides.**

The simple sugars that are made up of one sugar unit are known as monosaccharides.

Example:-

Glucose**: - Natural sugar found in food**

Fructose: - **fruit sugar and honey = the sweets of the simple**

Galactose: - **not found freely in nature**

The simple sugars that are made up of two sugars unit is known as disaccharides.

Examples:-

Sucrose: - **it is a product of** glucose **and** fructose**.**

Lactose: - **it is a product of** glucose **and** galactose

Maltose: - **it is a product of** glucose **and** glucose.

The best known simple sugar is table sugar, which is also known as sucrose, a disaccharide. Other simple sugars include the monosaccharide's glucose and fructose, which are found in fruits, and the disaccharides, which include sucrose, lactose (found in milk), and maltose (in beer and malt liquors).

B. Complex carbohydrates

It is made up of three to thousands of sugar molecules are linked together.

The larger carbohydrates are made up of these smaller simple sugars and are known as polysaccharides (many sugar molecules) or complex carbohydrates.

Unlike simple sugars, they do not have a sweet taste. It can classify in to two:-

1. Plant → **Starch**, **Fiber**

2. Animal → **Glycogen**

Examples of foods high in complex carbohydrates include

- potatoes,
- beans, and
- Vegetables.

During digestion, complex sugar (polysaccharides) are broken down into simple sugar (Disaccharides) and then to one unit sugar (monosaccharide's). These are absorbed in the small intestine and transported in the blood to the liver, where fructose and GA lactose are converted to glucose. The body utilizes most carbohydrates to generate glucose, which serves as the basic functional molecule of energy within the cells of the human body (glucose is broken down to ultimately produce adenosine triphosphate, or ATP, the fundamental unit of energy).

2.2. The Role of Carbohydrate in Physical Performance

Carbohydrates are the body's main energy source for all types of exercise. Carbohydrate is stored as glycogen in the body, and the amount of glycogen stored in the body affects stamina and endurance. When muscle cells run out of glycogen, fatigue sets in and performance will suffer, though the effects will vary among different sports. Training and eating properly, with particular attention to carbohydrates, can increase and maintain glycogen stores, which is particularly important for endurance athletes.

A large part of an athlete's diet should be carbohydrate. Foods high in carbohydrate include pasta, rice, cereals, starchy vegetables (e.g., potatoes, carrots, corn, and sweet potatoes), fruit, and bread. Not all carbohydrates are equal in providing needed nutrients, however. Focusing on carbohydrate from whole grains, fruits, and vegetables will make sure vitamins, minerals, fiber, and other important nutrients are part of one's diet, while filling up on too many sweets and processed foods can negatively impact sports performance.

What is carbohydrate loading?

Carbohydrate loading: - **is a technique used to increase the amount of glycogen in muscles. It involves eating extra carbohydrates during the week before a competition while at the same time cutting back on your training. Carbohydrate loading is intended for marathon runners and other elite athletes.**

2.2.1 Carbohydrates (CHO): Athletic Significance

- Primary source of energy
- Primary glucose source in the muscle & liver.
- Body stores glucose in the form of glycogen.
- Glucose is primary fuel for brain & the CNS.

CHO is involved in maintaining blood glucose levels which are vital to performance & appetite control.

2.2.2 Specific CHO Nutritional Needs

- ✓ Athletes who participate in high intensity sports should minimize their sugar & fat intake because they are primarily burning glycogen for energy.

- ✓ Individual CHO needs are based on your type of sport-activity & intensity.
- ✓ Typically, CHO requirements range 6-11 g/kg/of lean body mass.
- ✓ CHO needs are calculated on based on your LEAN BODY MASS!!!

2.3. Fat (Total Fat, Saturated Fats, Unsaturated Fats and Cholesterol)

Fat intake provides a major portion of our dietary energy (calories), but not the only source, and that fat intake must be considered in the context of carbohydrate intake, the other major source of dietary calories. Calories provided by dietary protein are not insignificant, but they definitely are minor compared to the energy provided by carbohydrates and fats. Keep in mind also that nutrient needs differ in a major way between athletes who perform more aerobic activities and those who perform more resistive types of exercise.

Objectives

At the end of this chapter you will be able to:

- Discuss the function of fat
- Understand how fat gained and stored
- Explain fat metabolism during exercise
- Identify the sources of fat meals
- Recognize the health effects of fat

2.3.1. Total Fat

The two types of fat in the body are: *essential* fat and *nonessential* fat, or storage fat. Essential fat is needed for normal physiological and biological functioning. It is found in bone marrow, the brain, the spinal cord, cell membranes, muscles, and other internal organs. The level of essential fat is approximately 3% of total body weight for men and 12% of total body weight 2 for women. Women have a higher essential body fat requirement because of gender-specific fat deposits in breast tissue and the area surrounding the uterus. When essential fat drops below a critical level, normal physiological and biological function may be impaired (Heyward and Wagner 2004).

Nonessential fat has three main functions:

1) As an insulator to retain body heat.

2) As an energy substrate during rest and exercise.

3) As padding against trauma.

Nonessential fat, known as storage fat, is typically layered below the skin and is referred to as *subcutaneous* fat. Storage fat is also found surrounding internal organs in the abdominal cavity and this fat is referred to as *visceral* fat. Older people tend to have less subcutaneous fat and more visceral fat than younger people (Heyward and Wagner 2004).

Relative Body Fat

The absolute amount of body fat, termed *fat mass*, includes all lipids from adipose and other tissues. Fat-free mass consists of all residual chemicals and tissues in muscle, bone, connective tissue, water, and internal organs. To classify body fatness, *relative* body fat or *percent* body fat is calculated. The terms relative body fat and percent body fat are used interchangeably. Relative fat is the fat mass that is expressed as a percent of total body weight. For example, %BF = fat mass ÷ body weight x 100. A person who weighs 175 lb and has a fat mass of 35 lb has relative body fat of 20% (35 ÷ 175 = .20 x 100 = 20%). Assessment of relative fat is commonly used for categorization in health and sports performance.

Activity 2.1

1. How fat is gained?
2. How fat is stored?

Storage fat is found in adipose tissue. Adipose tissue is a form of connective tissue composed of fat cells, called *adipocytes that* are separated by a matrix of collagenous (white fibrous protein) and elastic fibers. Body fat accumulates in two ways:

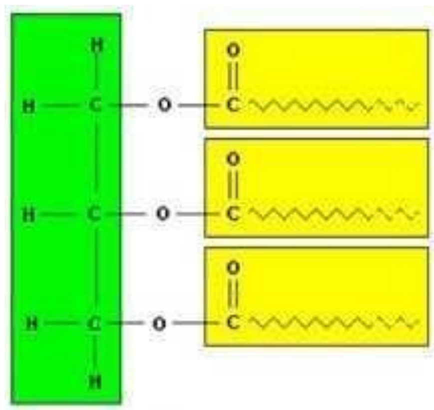
(1) *Hypertrophy* of fat cells: filling existing adipocytes, causing an increase in their size.

(2) *Hyperplasia* of fat cells: forming new fat cells.

Fat cells normally increase in size (hypertrophy) and number (hyperplasia) from birth to maturity. Obese adults typically have 60 to 100 billion fat cells compared with 30 to 50 billion fat cells found in non-obese adults (Pollock and Willmore 1990). Previous research indicates that the number of fat cells increased markedly during the first year of life, gradually until puberty, and then modestly for a period of several years, with the maximum number of cells becoming fixed by adulthood. Current evidence suggests that the size and number of fat cells can increase at any age. The exact mechanism for hyperplasia is still unknown; however, it is hypothesized that fat cells have a certain "size" capacity and once that capacity is reached a new cell is formed via hyperplasia (Liebman 2004). Fat cells can increase or decrease in size, but once a fat cell develops it is permanent and can be removed only by liposuction.

How Is Body Fat Stored?

Fat in the body is in the form of *triglycerides*. Triglycerides (TG) are made up of three free fatty acid (FFA) molecules held together by a molecule of glycerol (not a fat but a type of alcohol) (Brown, Miller, and Eason 2006) (figure 1).



Fatty acids

Glycerol molecule

Figure 1. Triglyceride molecule

Most of the body's fat is stored in the adipocytes. Typically, about 50,000 to 60,000 kilocalories (Kcals) of energy are stored as TG in adipocytes throughout the body (Manore and Thompson 2000). Fat can also be stored as "droplets" within skeletal muscle cells. These fat droplets are called ***intramuscular triglycerides*** (IMTG) and they may hold 2,000 to 3,000 kcals of stored energy (Manore and Thompson 2000). In addition to the stores of fat, some TG travels freely in the blood. During exercise, TG in fat cells, muscle cells, and in the blood can be broken down (a process called ***lipolysis*****)** and used as fuel by the exercising muscles.

Gender Differences in Fat Storage

Women generally have a higher percentage of body fat than men.

A healthy range of body fat for women 34 to 55 years old is 25% to 32%.

A healthy range for men the same age is 10% to 18% (Heyward and Wagner 2004).

For this age group, a body fat percentage of over 38% for women and 25% for men are considered an indication of obesity. Men tend to carry more of their body fat in and around the abdominal area. This type of fat deposition is called *android*, or apple-shaped, body type. The body type most common among females is the *gynoid*, or pear-shaped, body type. This body type is characterized by fat stores in the hip and thigh region (Regitz-Zagrosek, Lehmkuhl, and Weickert 2006). The scientific explanations for the dramatic difference in body fat distribution between men and women are largely unknown, although differences in hormones, hormone receptors, and enzyme concentrations play a contributing role.

Fats: are organic compounds that are made up of ***carbon, hydrogen and oxygen.***

- Fats have a smaller number of oxygen molecules than carbohydrates have.
- Though this small number of oxygen molecules makes fat **insoluble** in water, but soluble in certain organic solvents.
- They are a source of energy in foods. Fats belong to a group of substances called lipids and come in liquid or solid form.
- The basic structure of fats is a **glycerol** molecule consisting of three carbons, each attached to a fatty-acid chain. Collectively, this structure is known as a **triglyceride,** or sometimes it is called a triacylglycerol. Triglycerides are the major form of energy storage.

The energy contained in a gram of lipids is more than twice the amount in carbohydrates and protein, with an average of 9 kcal per g.

Based on:-

- The chemical structure of their longest and
- Dominant fatty acid,

Fat can be broken down into two types:-

A. **saturated**
B. **unsaturated**

A. Saturated Fats

Saturated fats are fatty acids, or are comprised of fatty acids, that contain no double bonds on their hydrocarbon backbone. The length of the carbon chains of saturated fatty acids varies from 4 to 24 carbon atoms. The most common saturated fatty acids found in nature are lauric acid (12:0), myristic acid (14:0), palmitic acid (16:0), and stearic acid (18:0), ranging in chain length from 12 to 18 carbons, as indicated. Saturated fats are the biggest dietary cause of high LDL levels (high density of lipo- protein "bad cholesterol"). When looking at a food label, pay very close attention to the percentage of saturated fat and avoid or limit any foods that are high. Saturated fat should be limited to 10% of calories.

Saturated fats are found in animal products such as:-

- ✓ butter
- ✓ cheese
- ✓ whole milk

- ✓ ice cream and
- ✓ Fatty meats

They are also found in some vegetable oils, coconut, palm, and palm kernel oils.

Note: most other vegetable oils contain unsaturated fat and are healthy

B. Unsaturated Fat

Fats that help to lower blood cholesterol if used in place of saturated fats. However, unsaturated fats have a lot of calories, so you still need to limit them. Most (but not all) liquid vegetable oils are unsaturated. (The exceptions include coconut, palm, and palm kernel oils.) There are two types of unsaturated fats:

- Monounsaturated fats: Examples include olive and canola oils.
- Polyunsaturated fats: Examples include fish, safflower, sunflower, corn, and soybean oils

Whether a fat is solid or liquid at room temperature largely depends on its property of being saturated or unsaturated. Fats from plant sources are largely unsaturated, and therefore liquid at room temperature. Fats that are derived from animals contain a higher amount of saturated fats, and they are therefore solid at room temperature. An exception to this rule is fish, which, for the most part, contain unsaturated fat. The most important difference between saturated and unsaturated fatty acids is;

Saturated fatty acids are the most important factor that can increase a person's cholesterol level. An increased cholesterol level may eventually result in the clogging of blood arteries and, ultimately, heart disease.

Not all fatty acids are considered harmful. In fact, certain unsaturated fatty acids are considered essential nutrients. Like the essential amino acids, these fatty acids are essential to a person's diet because the body cannot produce them. The *essential fatty acids* serve many important functions in the body, including regulating blood pressure and helping to synthesize and repair vital cell parts. Fats are also required for:-

- ❖ The **absorption** of fat-soluble vitamins
- ❖ They are generally thought to increase the taste and flavor of foods and
- ❖ To give an individual a feeling of fullness.
- ❖ Protect vital organs such as the heart and kidneys

Cholesterol

- ❖ Cholesterol is a fatty like substance belonging to the chemical group known as sterols.

- ❖ A high intake of saturated fat increase cholesterol level, but it is also found in red meats liver kidney egg yolk.
- ❖ A certain amount of cholesterol is needed by the body for building cells and producing hormones, but too much is harmful, as it contributes for heart disease.
- ❖ Cholesterol is bounded to two types of lipo-protein (a combination of lipids+ proteins):-
  1. High density lipo-protein (HDL): **-** this is good Cholesterol as it does not adhere to vessel walls and may even protect against heart disease; these are unsaturated fat
  2. Low density lipo-protein (HDL): - this is bad Cholesterol; these are saturated fat

The body's fat stores (intramuscular fat, adipose tissue, and blood lipids) are an abundant alternative fuel source. Whereas the total glycogen stores (in muscle and liver) provide only about 2000 kcal, each pound of fat supplies 3500 kcal. The amount of energy stored as fat is about 110,000 kcal for an 80 kg man and about 135,000 kcal for a 60 kg woman with average body composition. Thus, it is theorized that a high-fat diet will increase the rate of fat utilization and thus improve endurance performance. To understand if and how this might work, a brief explanation of fat metabolism during exercise and the effects of endurance training on fat metabolism is necessary.

2.3.2. Fat Metabolism during Exercise

Lipolysis, the breakdown of adipose (fat) cells to release their energy, requires activation of a lipase enzyme and results in the release of free fatty acids and glycerol into the cytoplasm of the cell. The enzyme hormone sensitive lipase (HSL) which stimulates lipolysis in both adipose and muscle cells is activated by the sympathetic nervous system and the hormone epinephrine, and inhibited by insulin and lactic acid. Circulating epinephrine activates HSL. Lactic acid also inhibits HSL. The hormonal environment generated by exercise (increased epinephrine and decreased insulin) promotes lipolysis and mobilization of fatty acids from intramuscular triglycerides and adipose tissue triglycerides. During low- to moderate-intensity exercise (below 65 percent of VO2max), the rate of appearance of plasma free fatty acids closely matches the rate of fat oxidation.

Relative fat oxidation is maximal at low to moderate intensities, whereas during high intensities (above 85 percent of VO2max), carbohydrate is the major fuel. The substance that actually is used by cells is adenosine triphosphate (ATP), which has been called the body's "energy currency." Because only a few ounces of ATP are present in the body at any given time, it must be constantly replenished to meet demands. Per unit of time, more ATP can be generated from carbohydrate than from the oxidation of fat. When blood borne fatty acids are oxidized, the maximum rate of ATP formation is about 0.40 mol/ minute whereas the aerobic or anaerobic breakdown of endogenous glycogen can generate about 1.0 to 2.0 mol/minute, respectively. During high-intensity exercise, the rate of ATP breakdown is too high to be matched by the rate of ATP formation from free fatty acids. This is the major reason that carbohydrate is the essential fuel for high intensity exercise High-intensity exercise also suppresses lipolysis, thereby reducing the availability of fatty acids to the muscles. The increased rate of glycogenolysis, glycolysis, and lactic acid production during intense exercise also hinders the oxidation of fat by reducing the entry of long-chain fatty acids into the mitochondria.

Endurance Training and Fat Metabolism

A major metabolic adaptation to endurance training is an increased capacity for fat oxidation. The contribution of fat to the total energy expenditure increases after endurance training at both the same relative and absolute exercise intensity. Most importantly, the trained muscles of athletes have a greater mitochondrial and capillary density, which enables them to oxidize more fat compared to the untrained muscles of sedentary people. This "glycogen sparing" effect allows the athlete to exercise longer before experiencing glycogen depletion and associated fatigue. Trained individuals are more sensitive to the hormonal milieu created by exercise, which promotes an increase in the activity of HSL in the trained compared to the untrained person.

Endurance training also decreases the secretion of insulin both at rest and during exercise. Trained individuals deliver more blood and oxygen to the muscles due to a higher cardiac output and increased arterio-venous oxygen difference (a higher VO2max). Trained individuals also produce less lactic acid at the same absolute and relative workloads due to a higher lactate threshold. Both of these adaptations to endurance training facilitate fat oxidation. Simply put, fat is a more concentrated form of energy, readily stored by the body. Since trained endurance athletes can utilize fat efficiently, the theory goes, they should "load" fat instead of carbohydrates. In testing that theory, researchers have found conflicting results.

Long-term fat loading

Adaptation to a high-fat diet or fat loading has been recommended to promote fat oxidation, slow the rate of carbohydrate utilization, and enhance endurance performance. Compared to a high-carbohydrate diet (60 to 70 percent energy from carbohydrate), fat loading (60 to 70 percent energy from fat) increases the contribution of fat oxidation to total energy expenditure and spares muscle glycogen during submaximal exercise (<70 percent of VO2max).

2.4. Body Reserves

Fatty acids introduced to the tissues are either utilized for energy or stored for later use, depending on the energy state of the body. In a fed state, fatty acids are primarily used for the synthesis of triglycerides in subcutaneous and deep visceral adipose tissue. While only approximately 450 g of glycogen can be stored in the body at one time, a nearly unlimited capacity for fat storage exists. Fat storage depends on the individual. For non-obese males average triglyceride storage ranges between and 15 kg, translating into a total energy storage of 80,000 to 140,000 kcal.

While trained athletes have less fat reserves, ample amounts remain to provide energy in times of prolonged periods of insufficient energy intake. Not only in caloric deprivation, but in states of high energy expenditure, carbohydrate availability may be limited and utilization of fat stores may be warranted. In addition to the fat storage in adipose tissue, a small amount of fat is present as lipid droplets in muscle tissues, or in circulation as free fatty acids associated with albumin or as part of a lipoprotein particle. The amount of fat both in the plasma and stored in muscle varies according to several factors, including energy state, fitness level, and dietary fat intake. Within the muscle cells, free fatty acids are primarily oxidized for energy.

2.4.1. Health Effects of Fat

Obesity and Diabetes

Obesity, often resulting from chronic excess of dietary energy, is strongly linked to both increased inflammatory status and type 2 diabetes. Visceral obesity, dyslipidemia, and insulin resistance are all conditions that, when they occur simultaneously, comprise what is termed the metabolic syndrome, increasing the risk for both diabetes and cardiovascular disease. Weight loss has been shown to decrease insulin concentration and increase insulin sensitivity. Obesity can be influenced by a variety of factors, including genetics, metabolism, environment, and socioeconomic status. Obesity is positively correlated to excess energy intake and low levels of physical activity. In addition, both the degree of total fat consumption and the type of fat consumed play a role in obesity.

Dietary fat intake is a significant predictor of sustained weight reduction and progression of type 2 diabetes in high-risk subjects. Short-term studies suggest that very high intakes of fat (>35% of calories) may modify metabolism and potentially promote obesity. Cross-cultural studies have also shown an increase in body mass index (BMI) in countries with higher intakes of fat. In part, the dietary intake of both saturated and total fat is related to the risk of developing diabetes, primarily through its association with a higher BMI. Modest reductions in total fat intake are suggested to facilitate a decrease in caloric intake, leading to better weight control and potential improvement in metabolic syndrome.

Coronary Heart Disease (CHD)

Atherosclerosis, the underlying pathological process of CHD, is characterized by an accumulation of plaque and fatty material within the intimae of the coronary arteries, cerebral arteries, iliac and femoral arteries, and the aorta. It is the atherosclerotic development in the coronary arteries that leads to CHD and its manifestations. The deposition and buildup of cholesterol and inflammation create reduced blood flow to the heart and possible thrombosis, and are the principle causes of myocardial and cerebral infarction. Plasma cholesterol concentrations are more subject to regulation by dietary fat than dietary cholesterol. As previously noted, short-term studies indicate that very high intakes of fat (>35% of calories) may have the ability to modify metabolism and potentially promote obesity.

3.4.2. Dietary Sources of Cholesterol and Fats

Only food of animal origin contains cholesterol. Organ meats and egg yolks are especially high in cholesterol, with moderate levels in meat, seafood, poultry, dairy products, and animal fats. According to the U.S. Department of Agriculture National Nutrient Database Standard Release 1 foods with the highest content of cholesterol per common measure, listed in descending order, are poultry giblets (419 to 641 mg/cup), beef liver (324 mg/3 oz), and one whole egg (245 mg/egg). Other foods considered high in cholesterol commonly eaten are shrimp and butter.

Dietary fat can be found in nearly all foods in varying amounts. Individual foods with high amounts of fat per common measure include all oils, meats such as pork and duck, nuts, and cheeses. Saturated fat, similar to cholesterol, mainly comes from animal sources. Foods with high amounts of saturated fat are red meat, poultry, butter, and whole milk. In addition to animal food sources, tropical oils such as coconut and palm kernel oil also contain considerable amounts of saturated fat, approximately 87 and 50% of total fatty acids, respectively.

2.5. Proteins

Introduction

In this chapter, the pathways of protein metabolism in skeletal muscle with emphasis on the effects of exercise on metabolic and anabolic regulation will be reviewed, including the factors that modify these responses. We will then review studies that have attempted to determine whether athletes require dietary protein intakes higher than those for sedentary individuals and whether protein quality influences metabolic and anabolic regulation. Throughout the chapter, exercise will be broadly classified as either endurance or resistance to highlight the two major classifications of exercise at opposite ends of the metabolic demand spectrum. Endurance activities can be broadly defined as those that utilize predominantly oxidative phosphorylation as the primary energy source; resistance activities lead to increases in strength, power, and muscle mass as outcomes.

Objectives

- Discuss the function of protein
- Explain exercise effects on protein metabolism
- List factors that affect protein metabolism
- Understand how much protein required for athletes

2.5.1 Protein: Quantity And Quality

The *quantity* of protein intake for athletic populations has been a matter of controversy for several years. Interest in protein intake can even be traced to ancient Greece, where records from the Olympics indicated that athletes consumed huge amounts of meat to try to maximize strength Performance. By the 18th century, muscle contraction was believed to be fueled by the oxidation of muscle protein. As the importance of lipid and carbohydrate (CHO) oxidation in muscle metabolism became clear, a central role for protein oxidation in the supply of energy during muscle contraction waned.

In contrast, the *quality* of protein intake for athletic populations has received much less scientific attention. Only recently have researchers attempted to distinguish the potential benefits of varying compositions of amino acids and protein type (e.g., whey vs. casein). The question as to whether physical activity of any type alters the dietary requirement for protein remains open for debate. Recommended Dietary Allowances (RDAs) for energy for adult males and females are 3100 and 2400 kcal/day, respectively, but these amounts are generally exceeded by active competitive athletes, though not necessarily by recreational athletes. RDAs, of course, depend on body size, and many athletes have high body mass indices (BMIs) without being obese; so the highly muscled athlete may need much more than the RDA, while the endurance-type, more aerobic athlete may need more than the RDA but not as much as the high BMI well-muscled types.

Table 2.1

Approximate Energy Distribution of Macronutrients

Macronutrient	General Diet	Endurance Athletes	Power Athletes
Carbohydrates	50%	65%	55%
Fats	35%	20%	25%
Proteins	15%	15%	20%

Some endurance athletes increase their intakes of energy and protein through the use of supplemental powders that may also contain micronutrients, i.e., vitamins and minerals. These athletes can greatly increase their intakes, especially while participating in their sports by diluting these powders in water and carrying their bags on their backs. Supplements are generally considered to help these athletes, who may be on the road or trail for hours at a time. Almost all other athletes do not need to go to such lengths to meet their energy and protein needs, but they may need breaks from time to time to consume an energy drink or bar. In general, trained athletes do not wish to gain or lose weight, but rather to stay at their weight of optimal performance.

These athletes typically consume foods with high nutrient density, i.e., fairly rich in micronutrients per total amount of energy in a serving, and they commonly take a nutrient supplement of one type or another, depending on their specific sport or activity. Recreational athletes should also try to include more nutrient-rich foods in their diets, and they may also wish to take a daily supplement of vitamins and minerals appropriate for age and gender. Proteins are chemically different from carbohydrate and fats, and are complex in structure.

Activity 2.1

1. What are the major functions of protein?

2. Explain the effects of exercise on protein metabolism?

Proteins are composed of the elements carbon **(C), oxygen (O), hydrogen (H)** and **nitrogen** (N).

They have a variety of uses in the body including:-

- serving as a source of energy
- as substrates (starter materials) for tissue growth and maintenance and
- for certain **biological** functions, such as:-
    - ✓ Taking structural proteins
    - ✓ Transfer proteins

- ✓ **Enzyme** molecules and
- ✓ **Hormone** receptors.

- Proteins are also the major component in bone, muscle, and other tissues and fluids.

When used for energy protein supplies an average of 4 cal/g.

Proteins are formed by the linking of different combinations of the twenty common amino acids found in food. Of these, eight are essential for the human in the synthesis of body proteins. Protein may be found in a variety of food sources. Proteins from animal sources (meat, poultry, milk, and fish) are considered to be of high biological value because they contain all of the essential amino acids. Proteins from plant sources (wheat, corn, rice, and beans) are considered to be of low biological value because an individual plant source does not contain all of the essential amino acids. Therefore, combinations of plant sources must be used to provide these nutrients.

2.5.3. Protein Metabolism

Proteins are important molecules comprised of amino acids — compounds containing an amino group (–NH), a carboxylic acid group (–COOH), and a radical group (different for each of the amino acids). There are 20 amino acids that are found as constituents of proteins or present as free amino acids. Nine amino acids are considered essential or indispensable (histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, valine), and arginine is sometimes considered to be conditionally essential. The essential amino acids must come from the diet or from endogenous protein breakdown. Since proteins serve such critical roles in the survival of the organism, it is not surprising that their metabolism is complex, tightly regulated, and in a constant state of flux with simultaneous synthesis and degradation.

There are two types of exercise effects on protein metabolism:

2.5.4. Acute Exercise Effects on Protein Metabolism

Endurance Exercise

The majority of the energy for endurance exercise is derived from the oxidation of lipid and CHO. As mentioned above, skeletal muscle has the metabolic capacity to oxidize certain amino acids for energy. While it may seem counterproductive to oxidize proteins during exercise since they serve either a structural or functional role, amino acid oxidation may also be required for exchange reactions in the tricarboxylic acid cycle, and this may increase their net utilization.

Early studies evaluated urea excretion as an indicator of protein oxidation (urea is a breakdown product formed in the liver following amino acid oxidation) and found that urinary urea excretion was higher following endurance exercise than at rest. This increase is missed if sweat is not collected because urea and other nitrogen compounds are contained in sweat. For example, a person exercising in high ambient temperatures or humidity with a sweat rate of up to 2 l/h would be expected to have a high urea sweat loss that may contribute to a more negative nitrogen balance.

Table 2.2

Energy Requirements during a 1-h Run at 65 to 75% of VO2max

	Energy (kcal/h)	% Fat	% Protein	% CHO
Males	816 (122)	24 (19)	5 (3)	71 (24)
Females	603 (45)	38 (17)	2 (2)	60 (18)

Since urea excretion represents the full extent of amino acid oxidation, this method provides only indirect evidence for amino acid oxidation and, in some cases, does not correlate well with direct measures of amino acid oxidation. By far, the amino acid leucine has been most often used to trace the effects of exercise on amino acid oxidation, and many studies have shown that endurance exercise increases leucine oxidation. An increase in lysine oxidation has also been observed during endurance exercise. During endurance exercise, leucine oxidation demonstrates a positive correlation with exercise intensity. Leucine oxidation and plasma urea content also increase with exercise duration. Finally, leucine oxidation increases with glycogen depletion, which may partially explain the increase in leucine oxidation with exercise duration.

Resistance Exercise

In contrast to endurance exercise, acute whole-body resistance exercise does not alter leucine oxidation. In this same study we also did not find an effect of acute resistance exercise on whole-body protein synthesis, either during exercise or for up to 2 h post-exercise. We hypothesized that since muscle protein synthesis (MPS) accounted for only 25% of whole-body synthesis, changes in MPS either may be no measurable or would be negated by a reciprocal change in the synthesis of another protein, such as one in the gastrointestinal tract. To measure the acute effect of resistance exercise on muscle-specific protein synthesis, several groups have used the FSR tracer incorporation method described above. We demonstrated that mixed-muscle FSR was elevated for up to 36 h following a single bout of resistance exercise. Other groups have also shown the increase in muscle protein synthesis after an acute bout of resistance exercise using FSR and arteriovenous balance methods.

2.5.5. Chronic Exercise Effects on Protein Metabolism

Endurance Training

Since proteins serve either a structural or functional role within the cell, chronic endurance exercise training would be expected to achieve adaptations that would attenuate the oxidation of protein for energy. Early work by Gontzea et al. showed that untrained persons who started endurance training were in a negative nitrogen balance, but as they continued to train, the nitrogen balance became less negative. To date, human data have not yielded consistent findings on the effects of chronic exercise training on protein metabolism. Following endurance exercise training, whole-body protein synthesis at rest is increased. There is also a greater proportion of leucine flux at rest diverted toward oxidation in the untrained vs. trained athlete. However, differences in leucine turnover between trained and untrained subjects disappeared when the data were expressed relative to lean mass.

These findings are not consistent with the hypothesis that endurance exercise training attenuates glycogen use and spares protein oxidation. For this reason we designed an experiment to train sedentary individuals for days and to measure their leucine oxidation during exercise, before and after the training. We found that leucine oxidation during exercise was lower after training. However, consequent to the increase in total mitochondrial content. Our findings were confirmed in a recent study that showed that resting amino acid oxidation was lower after endurance exercise training. Taken together, data from the latter two studies confirm that chronic endurance training results in a sparing of amino acid oxidation. However, it is likely that only top sport athletes training for long hours and at a high relative intensity or during periods of nutritional stress (i.e., low energy or CHO intake) could ever strain metabolic capacity such that the daily amount of amino acid oxidation would exceed that in the untrained or moderately trained individual.

Resistance Training

Although there are fewer training studies concerning resistance exercise, it is logical that protein requirements/synthesis would be greater in the early stages of adaptation when the initial hypertrophy is achieved than in a long-term maintenance phase (assuming no compensatory changes in reutilization). We demonstrated that whole body protein synthesis and degradation were greater in resistance-trained athletes than in sedentary controls; furthermore, others have found that basal FSR was higher after a period of resistance exercise training. In addition, there is an attenuation of the acute exercise-induced increase in mixed-muscle FSR following a period of resistance exercise training. This latter finding would predict that a trained weight lifter could have either a lower (reduced post-exercise pulse) or a higher (elevated basal FSR) protein requirement. The elevation in basal mixed FSR after training is consistent with the finding of a higher whole-body protein synthesis in well-trained resistance athletes than in sedentary controls. However, protein requirements appear to be lower for well-trained resistance-trained athletes than for those starting a training program, but still marginally elevated as compared with sedentary individuals. A study of resistance training in older adults suggested that protein efficiency was enhanced following a resistance training program.

2.5.6. Factors Affecting Protein Metabolism

Energy Intake

Energy is a classical determinant of protein metabolism, with suboptimal energy intake leading to a relative increase in protein oxidation. Conversely, an increase in total energy intake was associated with an improvement in protein balance in young women who performed endurance exercise on a daily basis. Most men and women consume enough energy and protein to accommodate any possible increase in protein requirements; however, the goal of the sport nutritionist is to identify and work with athletes who have unique and special needs.

Carbohydrate (CHO) Intake

It has been known for many years that CHO intake has a significant sparing effect upon amino acid oxidation and protein balance. The dietary interaction between protein and CHO may have implications for those athletes who habitually consume fad diets that stress a very low CHO intake. Given that CHO is the predominant fuel utilized during endurance exercise, and that this substrate can become depleted during prolonged endurance exercise, it is important for amino acid metabolism to be considered in light of CHO intake and storage (i.e., glycogen) status of the athlete. CHO loading has been shown to attenuate plasma and sweat urea excretion following endurance exercise. Furthermore, CHO supplementation increases whole-body protein synthesis and attenuates proteolysis. We have reported that both men and women show attenuated total amino acid oxidation (serial urinary urea excretion) during endurance exercise when CHO supplements are consumed during exercise.

Timing of Nutrient Delivery

There has been an interest in the timing of nutrient delivery and the effects on glycogen synthesis in the recovery from endurance exercise. Studies have demonstrated that glycogen re-synthesis is more rapid if the glucose is provided in the immediate post-exercise period vs. a 2-h delay, and that there may be a synergistic effect from the addition of protein to glucose drinks.

Hormones

Although there are many hormones that directly and indirectly affect protein turnover (e.g., insulin, testosterone, growth hormone, and insulin-like growth factor), only testosterone and insulin will be discussed here. Testosterone is of interest because of the significant controversy surrounding its unethical use in sporting events and its potent effects on protein metabolism. For many years testosterone was assumed to possess stimulatory effects on net protein synthesis, based on observations of male/female differences in lean mass as well as the increases noted for those who supplemented with pharmacological doses. Consequently, proper investigations into the metabolism and efficacy of testosterone administration followed. Even without resistance exercise, testosterone administration can increase lean body mass, and a resistance exercise training program can magnify these effects. At the muscle level, testosterone acts by increasing protein synthesis and intracellular amino acid reutilization and not degradation. Given the fact that acute resistance exercise also increases plasma testosterone concentration, it will be important to conduct properly designed studies to compare the efficacy of an optimal nutritional intervention to that of exogenous testosterone supplementation.

Gender/Sex

A number of studies have examined the influence of gender/sex on metabolic fuel selection during endurance activity. Overall, women appear to oxidize proportionately more lipids and less CHO than men during endurance exercise. The lower contribution from CHO in exercising females would imply that amino acid oxidation should also be lower than in men. In an earlier study using 24-h urinary urea excretion as a marker of total amino acid oxidation, we found that men, but not women, showed elevated 24-h urinary urea during a day in which they completed a 15.5-km treadmill run as compared to a rest day. Using leucine as a stable isotope tracer, our group and others found that women oxidized proportionately less leucine than men during endurance cycling. The reduced leucine oxidation observed for women during endurance exercise is apparent prior to and following days of endurance exercise training.

2.5.7. Assessment of Dietary Protein Requirements

Activity 2.2

1. How we measure protein requirement?

Overall, dietary protein requirements represent the amount of protein that is required to support net protein synthesis (growth, repair of damaged tissues, lactation, pregnancy, muscle hypertrophy, enzyme synthesis), amino acid oxidation, and the inefficiency inherent in the amino acid recycling process. The two methods of determining protein requirements are the NBAL method .As defined above, NBAL is the method whereby the investigator determines all of the protein that enters a person (diet, intravenous, etc.) and all of the nitrogen that is excreted. Since the body exerts nitrogenous compounds rather than whole proteins and since proteins are ~16% nitrogen by weight, the technique involves measurement of the total nitrogen intake and the total nitrogen excretion (urine, feces, sweat, and miscellaneous, e.g., menstrual loss, hair, semen, and skin). If the person is in a state of net anabolism, then there is a positive NBAL, whereas if the person is losing protein, then there is a negative NBAL.

2.6. Dietary Protein Requirements For Athletes

In most countries there are no specific allowances for an effect of physical exercise on protein requirements. It is sometimes stated that these are not required because all athletes consume more energy and subsequently achieve adequate protein intakes. Others have argued that moderate exercise does not increase the requirement for dietary protein, and therefore there is no need to provide specific protein requirements for athletes. However, these studies were undertaken using exercise intensities that would be considered recreational by most standards. Clearly, an elite athlete is performing daily exercise at a much higher intensity and for a longer duration than the novice.

2.6.1. Protein Requirements for Endurance Athletes

Given that amino acids can be oxidized as energy during exercise, it is theoretically possible that this may impact on the need for extra dietary protein. The determination of dietary protein requirements for endurance athletes is a function of the duration and intensity of exercise, gender, age, training status, and habitual energy and CHO intake. In a simplistic approach to determining protein requirements, it is possible to calculate the estimated need for dietary protein by an athlete from first principles. For example, if a 70-kg male was running for 1.5 h at 70% VO2peak and protein accounted for 5% of the total energy expenditure, he would oxidize about 15 g of protein. If his basal protein requirement was 0.86 g/kg/day (60 g), this would represent an additional 25% increase in his daily protein requirement (1.07 g/kg/day). Most male and female endurance athletes habitually consume more protein than this (Table 3.2). These calculations are only rough estimates and most studies have used NBAL to try to quantify dietary protein requirements for endurance athletes.

Table 2.3

Estimated Protein Requirements for Athletes

Group	**Protein Intake (g/kg/day)**
Sedentary men and women	0.80–1.0
Elite male endurance athletes	1.6
Moderate-intensity endurance athletes	1.2
Recreational endurance athletes	0.80–1.0
Football, power sports	1.4–1.7
Resistance athletes (early training)	1.5–1.7
Resistance athletes (steady state)	1.0–1.2
Female athletes 15% lower than male athletes	

Partially adapted from Tarnopolsky, M., *Nutrition*, 20, 662, 2004.

We determined the safe protein intake for the elite athletes to be 1.6 g/kg/day, whereas the estimate for a sedentary control group (N = 6) was 0.86 g/kg/day, which was very close to Canadian and U.S. recommendations. In the elite athlete, the increase in dietary protein requirements may be as high as 1.6 g/kg/day (or nearly twice the recommended intake for sedentary persons).

2.6.2. Protein Requirements for Resistance Athletes

In contrast to endurance exercise, resistance exercise results in muscle hypertrophy rather than an increase in amino acid oxidation and mitochondrial biogenesis. If, for example, there are no changes in efficiency of amino acid retention, there must, at some point, be a protein intake in excess of basal requirements to provide the amino acids required for anabolism. The extent of this increased need is again a function of the basal state of training, the duration, and the intensity of the training program. An early study used NBAL and lean mass measurements to estimate the protein requirements during an isometric exercise training program. They found that a daily protein intake of 1.0 g/kg (egg white and milk) was required to maintain positive NBAL and lean mass accretion in males performing isometric exercise for 75 min/day. The equivalent protein intake from a mixed source would be about 1.2 g/kg/day. Similar results were found in young males performing circuit training with both endurance and resistance exercise where even after 40-day adaptation period protein requirements were ~1.4 g/kg/day.

2.7. Micro-nutrients (vitamins, minerals)

At the end of this chapter you will be able to;

- List down micronutrients
- Describe the nutritional aspects of micronutrients in sport
- Explain the micronutrients reserve and influence of exercise

Micro nutrients: - are nutrients that have no energies and we need in small quantity:-

Vitamins

Minerals

All vitamins and minerals are important. Two that deserve special attention from athletes are iron and calcium. Iron is important to carry oxygen in blood, and it plays a key role in sports performance. The best sources of iron are lean red meats, shrimp, iron-fortified cereals, and bread products. Calcium keeps bones strong. Foods from the dairy group, including milk, yogurt, and cheese are excellent sources of calcium. Non-dairy sources of calcium include dark leafy green vegetables, but the calcium may not be absorbed as well. There are also many calcium-fortified juices and foods that can help boost calcium intake. In addition, weight-bearing exercises increase bone density.

Vitamins & Minerals: Athletic Significance

Vitamins & minerals are needed for normal metabolism, growth, maintenance & repair of tissues aside from overall health. Dietary surveys show that most athletes are deficient in one or several vitamins and/or minerals. Optimum vitamin intake is attained from foods & supplements.

1. To what extent are requirements for micronutrients increased by regular exercise?
2. Do micronutrient intakes above the recommended daily intakes further enhance exercise performance?

Vitamins

Vitamins are chemical compounds that are essential nutrients which enable the body to function efficiently, but they do not provide energy.

Vitamins are essential for:-

- Regulate metabolic processes
- Growth
- Function of the nervous system and immune system

- In enzyme production and
- A number of metabolic reactions

There are thirteen vitamins, which may be divided into two groups: -

1. **Fat-soluble vitamins: -** four in number and stored in the liver and in fatty tissue. It include:-
   - **Vitamins A**:- to aids growth and repair of tissue
   - **Vitamins D: -** increase the absorption of calcium and promotes the growth of bones.
   - **Vitamins E:** - helps muscles to utilize oxygen and may aid recovery after exercise.
   - **Vitamins K:** - essential in blood clotting.

2. **Water-soluble vitamins: -** nine in number are execrated in the urine. (Vitamins B complex and vitamin C).

These two groups are dissimilar in many ways.

1. Cooking or heating destroys the water-soluble vitamins much more readily than the fat-soluble vitamins.
2. Fat-soluble vitamins are much less readily excreted from the body, compared to water-soluble vitamins, and can therefore accumulate to excessive, and possibly toxic, levels.

This means, of course that levels of water-soluble vitamins in the body can become depleted more quickly, leading to a vitamin deficiency if those nutrients are not replaced regularly. Organic compounds, found in small amounts in foods, are designated as nutrients because they cannot be synthesized by the body and are required to support health and wellbeing. Vitamins catalyze numerous biochemical reactions. They are not direct sources of energy; vitamins facilitate energy metabolism. Because the rates or activities of these metabolic processes increase during physical activity, an adequate supply of vitamins is needed to promote optimal physical performance. Vitamins are classified based on their solubility in water or fat.

Water-Soluble Vitamins

The B vitamins and vitamin C (ascorbic acid) are water-soluble vitamins. The B vitamins (thiamin, riboflavin, niacin, pyridoxine, folate, biotin, pantothenic acid, and choline) regulate energy metabolism by modulating the synthesis and degradation of carbohydrate, fat, protein, and bioactive compounds. Vitamin B12 is required for hemoglobin synthesis and vitamin C acts as an antioxidant.

Fat-Soluble Vitamins

Vitamins A, D, E, and K are stored in adipose tissue in substantial amounts. These fat-soluble vitamins have no direct role in energy metabolism; they function in roles supportive of energy use. B-Carotene, a precursor of vitamin A, and vitamin E act as antioxidants in reducing muscle damage and enhancing recovery from exercise. Vitamin D, which promotes calcium absorption and use in bone formation, and vitamin K, which functions in coagulation and bone formation, has not been shown to influence exercise performance.

Minerals

Minerals are different from the other nutrients discussed thus far, in that they are inorganic compounds (carbohydrates, proteins, lipids, and vitamins are all organic compounds). The fundamental structure of minerals is usually nothing more than a molecule, or molecules, of an element. The functions of minerals do not include participation in the yielding of energy.

But they do play vital roles in several **physiological** functions including:

- critical involvement in **nervous system** functioning,
- in cellular reactions,
- in water balance in the body, and
- In structural systems, such as the skeletal system.

Because minerals have a very simple structure of usually one or more molecules of an element, they are not readily destroyed in the heating or cooking process of food preparation. However, they can leak out of the food substance that contains them and seep into the water or liquid the food is being cooked in. This may result in a decreased level of minerals being consumed if the liquid is discarded. Twelve minerals are designated as essential nutrients. Magnesium, iron, zinc, copper, and chromium, whose essentiality is controversial, have biochemical functions with the potential to affect physical performance. These minerals serve as structural or catalytic components of enzymes and regulate cellular energy transduction, gas transport, antioxidant defense, membrane receptor functions, second-messenger systems, and integration of physiologic systems. Thus, mineral elements regulate macronutrient use. There are many minerals found within the human body, but of the sixteen (or possibly more) essential minerals, the amount required on a daily basis varies enormously.

This is why minerals are subdivided into two classes:-

1. **Macro minerals**
2. **Micro minerals**

Macro minerals: - include those that are needed in high quantities, ranging from milligrams to grams.

Examples:-

- Calcium

- Phosphorous and
- Magnesium

Micro minerals: - are those necessary in smaller quantities, generally between a microgram and a milligram.

Examples: -

- Copper
- Chromium and
    - Selenium

Minerals account for roughly 4% of a person's body mass. They provide the structure for forming bone and teeth. They also help muscles to contract, maintain normal heart rhythm and control the acid-base balance as well as other important bodily functions. Minerals are classed as either **major** or **trace** depending on how much is required per day. Major minerals include calcium, phosphorus, sodium, potassium and magnesium. Trace minerals include iron, zinc, copper, selenium and chromium.

Calcium

The typical Western diet contains too little calcium. The RDA for calcium is 800-1000 mg for adults and 1200 mg for adolescents. The average adult consumes just 500-700 mg per day and for many it's as little as 300 mg per day. Calcium deficiency can lead to a condition called osteoporosis - a weakening of the bones. Exercise actually helps to maintain healthy bone density.

Sodium

Most adults consume too much sodium (found in abundance in processed foods), which can lead to high blood pressure. The RDA of 1100-3300 mg is equivalent to 0.5-1.5 teaspoons of table salt. Most people consume more than 2 teaspoons from processed foods even when table salt isn't used as seasoning.

Iron

Iron is helps the blood to carry oxygen so an iron deficiency (called anemia) can lead to fatigue even with mild exercise. Some research has suggested that heavy exercise training creates an increased demand for iron. However, even in elite athletes, supplements are unnecessary if the diet contains iron-rich foods. As with vitamins there is no convincing research to suggest taking mineral supplements can improve sporting performance. Exceeding the recommended daily allowance can also be potentially harmful. The only exception is adding a small amount of sodium to sports drinks during hot weather.

Summary

Vitamins and minerals play a key role in optimizing the health and performance of the athlete. However, there are no fixed guidelines for recommended intakes of vitamins and minerals by athletes. Rather it is suggested that a moderate to high energy intake, coupled with a variety of nutrient-rich food choices, will enable the athlete to achieve intakes of vitamins and minerals that are in excess of both the population recommended dietary intakes, and their increased requirements. Studies fail to provide evidence that vitamin supplementation enhances exercise performance, except in cases where there was a pre-existing deficiency. With regard to minerals, some athletes are at risk of suboptimal intakes of iron and calcium, which may have detrimental effects on either immediate performance or long-term health.

CHAPTER THREE

3. FLUID IN SPORT

Objectives

At the end of this unit you will be able to;

- ❖ Understand the effect of fluid in sport.
- ❖ Know when and where to use each nutrients

3.1. Introduction

Maintaining proper body hydration levels during an exercise session is critical for health, safety, and optimal performance. Dehydration leads to heat illnesses (i.e. muscle cramps, heat exhaustion, and heat stroke) and possible death. Normal hydration levels become more difficult to maintain as the exercise session increases and/or the exercising environment has high temperatures with or without high humidity. There are three distinct hydration periods for optimal body fluid levels:

1. pre-exercise,
2. During exercise, and
3. Post-exercise.

If you exercise regularly, it's important to think not only about what you eat, but about how much (and what) you drink. And because exercise speeds up water loss, it's critical to know how to stay properly hydrated. Water is essential for keeping your body temperature normal. It also cushions your joints and helps get nutrients in and waste out. If you don't drink enough, you can become dehydrated, which will affect your performance. It can make you tired and cause dry mouth, headaches, light headedness and constipation. Sodium, chloride and potassium are electrolytes that help your body function normally. Sweating causes you to lose water and electrolytes. Exercising in hot weather can increase that loss. If excessive losses are not replenished, you may feel dizzy or weak. You may even suffer heat exhaustion or heat stroke. These are very serious conditions that require prompt medical attention. Athletes need to stay hydrated for optimal performance. Studies have found that a loss of two or more percent of one's body weight due to sweating is linked to a drop in blood volume. When this occurs, the heart works harder to move blood through the bloodstream. This can also cause muscle cramps, dizziness and fatigue and even heat illness including:

- Heat Exhaustion
- Heat Stroke

Depletion of the body's carbohydrate stores and dehydration are two factors that will limit prolonged exercise.

3.2. Hydration & Dehydration

Because there is wide variability in sweat rates, losses and hydration levels of individuals, it is nearly impossible to provide specific recommendations or guidelines about the type or amount of fluids athletes should consume. Finding the right amount of fluid to drink depends upon a variety of individual factors including the length and intensity of exercise and other individual differences. There are, however, two simple methods of estimating adequate hydration:

Monitoring urine volume output and color a large amount of light colored, diluted urine probably means you are hydrated; dark colored, concentrated urine probably means you are dehydrated.

Weighing you before and after exercise any weight lost is likely from fluid, so try to drink enough to replenish those losses. Any weight gain could mean you are drinking more than you need. Sweating is the way in which the body maintains its core temperature at 37 degrees centigrade. This results in the loss of body fluid and electrolytes (minerals such as chloride, calcium, magnesium, sodium and potassium) and if unchecked will lead to dehydration and eventually circulatory collapse and heat stroke.

Fluid absorption

Two main factors affect the speed at which fluid from a drink gets into the body:

- the speed at which it is emptied from the stomach
- the rate at which it is absorbed through the walls of the small intestine

Causes of Dehydration

- Inadequate fluid intake
- Excessive sweating
- Failure to replace fluid losses during and after exercise
- drinking only when thirsty
- **High altitude** exercising at altitude increases your fluid losses and therefore increases your fluid needs.
- **Temperature** Exercising in the heat increases you fluid losses through sweating and exercise in the cold can impair your ability to recognize fluid losses and increase fluid lost through respiration. In both cases it is important to hydrate.
- **Sweating** Some athletes sweat more than others. If you sweat a lot you are at greater risk for dehydration. Again, weigh yourself before and after exercise to judge sweat loss.
- **Exercise Duration and Intensity** Exercising for hours (endurance sports) means you need to drink more and more frequently to avoid dehydration

Seven Rules of Hydration

1. The rate of passage of water from your stomach into your small intestine depends on how much fluid is actually in your stomach. If there is lots of water there, fluid flow from stomach to intestine is like a springtime flood; if there is little water, the movement resembles a lightly dripping tap. Therefore, to increase stomach-intestinal flow (and overall absorption of water) you need to deposit a fair amount of liquid in your stomach just before you begin your exercise. In fact, 10-12 ounces of fluid is a good start. This will feel uncomfortable at first, so practice funneling this amount of beverage into your "**tank**" several times before an actual competition.

2. To sustain a rapid movement of fluid into your small intestine during your exertions, take three to four sips of beverage every 10 minutes if possible, or five to six swallows every 15 minutes.

3. If you are going to be exercising for less than 60 minutes, do not worry about including carbohydrate in your drink; plain water is fine. For exercise that is more prolonged you will want the carbohydrate.

4. Years of research have suggested that the correct concentration of carbohydrate in your drink is about 5 to 7%. Most commercial sports drinks fall within this range, and you can make your own 6% drink by mixing five tablespoons of table sugar with each liter of water that you use. A bit of sodium boosts absorption; one-third teaspoon of salt per liter of water is about right. Although 5 to 7% carbohydrate solutions seem to work best for most individuals, there is evidence that some endurance athletes can fare better with higher concentrations. In research

carried out at Liverpool John Moores University, for example, cyclists who ingested a 15% maltodextrin solution improved their endurance by 30 per cent compared to individuals who used a 5% glucose drink. The 15% drink also drained from the stomach as quickly as the 5% one, though many other studies have linked such concentrated drinks with a slowdown in water movement.

5. A 6% "simple sugar" drink will empty from your stomach at about the same rate as a fancy 6% "glucose polymer" beverage, so do not fall for the idea that the latter can boost water absorption or enhance your performance more than the former, and don't pay more for the glucose-polymer concoction.

6. Contrary to what you have heard, cold drinks are not absorbed into your body more quickly than warm ones. However, cold drinks are often more palatable than warm ones during exercise, so if coldness helps you to drink large quantities of fluid while you exert yourself, then keep your drinks cool.

7. Swilling drinks during exercise does not increase your risk of digestive-system problems. In actuality, most gut disorders that arise during exercise are caused by dehydration, not from taking in fluid. Dehydration induces nausea and discomfort by reducing blood flow to the digestive system, so keep drinking!

Hyponatremia - Water Intoxication

Intracellular fluid and interstitial fluid have the same osmotic pressures under normal circumstances. The principal captions inside the cell are Potassium and the principal caption outside the cell is Sodium. A fluid imbalance between these two compartments is caused by a change in the Potassium or Sodium concentration. Sodium balance in the body is controlled by aldosterone and antidiuretic hormone (ADH). ADH regulates extracellular fluid electrolyte concentration by adjusting the amount of water reabsorbed into the blood by the kidneys. Aldosterone regulates extracellular fluid volume by adjusting the amount of sodium reabsorbed by the blood from the kidneys.

Certain conditions may result in a decrease in the sodium concentration in interstitial fluid. For instance, during sweating the skin excretes sodium as well as water. If we replace the lost fluid with plain water then we may produce a sodium deficit. The decrease in sodium concentration in the interstitial fluid lowers the interstitial fluid osmotic pressure and establishes an effective water concentration between the interstitial fluid and the intracellular fluid. Water moves from the interstitial fluid into the cells, producing two results that can be quite serious:

- The first result, an increase in intracellular water concentration, called over hydration which disrupts nerve cell function. In severe over hydration we may see disoriented behavior, convulsions, coma, and even death
- The second result is a loss of interstitial fluid volume that leads to a decrease in the interstitial fluid pressure. As the pressure drops, water moves out of the plasma, resulting in a loss of blood volume that may lead to circulatory shock.

Adequate fluid intake is the single most important recommendation for all types of exercise.

Fluid guidelines

Experts advise that you drink before, during and after your workout. How much fluid you need depends on several factors:

- How much you sweat
- Your body size, weight and muscle mass
- Heat and humidity conditions
- The intensity of your workout
- Medications you are taking
- Your medical history
- Your age

- Children and the elderly are also more prone to dehydration and will have different fluid requirements during exercise.
- Hyponatremia is a rare yet possibly life-threatening condition that occurs when you drink too much water. It happens when the kidneys can't flush out the excess water. This dilutes the electrolyte content in the blood, which leads to low sodium levels. This is very uncommon, and is mainly seen in endurance athletes, such as marathon runners.
- If you find you are not drinking enough fluids for exercise, it's not hard to get into the habit. Increase your intake gradually, and in time you'll easily consume what you need. **Talk to your doctor if you have any concerns about exercise and hydration.**

3.3. Hydration before Exercise

Objectives

- The goal of drinking fluids before exercise is to be well hydrated before you are physically active

Guidelines

- Drink about 15-20 fl oz, 2-3 hours before exercise
- Drink 8-10 fl oz 10-15 min before exercise.

- If you have rested for at least 8-12 hours before activity and eat and drink regularly, extra hydration may not be needed. If you have lost fluids from sweating prior to exercise, have not been regularly drinking, or have dark, concentrated urine, then you may need 1-2 cups four hours before you begin exercising and another ½ - 1 cup two hours before.
- Start by drinking fluids several hours before your workout. This will promote a normal fluid and electrolyte balance.
- All athletes should consume 400 to 600 ml (about 1 ½ to 2 ½ cups) of fluid two to three hours before exercising. This amount of fluid will help ensure that the athlete is not dehydrated and will allow the athlete enough time to absorb the fluid and comfortably eliminate urine before training or competition begins.
- Athletes who exercise in the heat should consume an additional 250 to 500 ml (1 to 2 cups) within two hours of the onset of exercise.
- Athletes who train or perform more than one hour may choose a carbohydrate beverage (CHO) instead of just water. The concentration of the carbohydrate beverage should not be more than 8%, although some athletes can tolerate higher concentrations.
- Fifteen to 30 min. before exercise, 300 to 500 ml more of a CHO beverage is consumed.
- Consuming a sports beverage before prolonged activity gives the endurance athlete the advantage of being able to delay fatigue (through carbohydrate intake) and prevent dehydration.

Proper hydration levels before starting the physical activity is necessary regardless of the length of the exercise session or environmental conditions (i.e. hot or cold). Any fluid deficit prior to exercise can potentially compromise thermoregulation during the session. This dehydrated state increases the cardiovascular strain and limits the body's ability to transfer heat from the contracting muscles to the skin surface where heat can be dissipated. This condition also causes a decrease in performance for both aerobic and anaerobic activities.

 During the 24 hour period prior to the exercise session adequate fluids should be consumed to promote proper hydration. Starting about two hours before the exercise activity, approximately 500 milliliters or 17 ounces of water should be ingested. This fluid intake should be consumed gradually to elevate the hydration level above normal values causing a hyper hydrated state. If this pre-exercise water is consumed too quickly, the kidneys will slow their reabsorption rate leading to excretion of the excess ingested water.

3.4. Hydration during Exercise

Objectives

- ❖ To prevent dehydration.
- ❖ Essential to comfort, performance and safety.

Guidelines

- Drink 8-10 fl oz every 10-15 min during exercise.
- If exercising longer than 90 minutes, drink 8-10 fl oz of a sports drink (with no more than 8 percent carbohydrate) every 15 - 30 minutes.
- Fluid losses as little as 2% of body weight can reduce your performance by 10% or more. If you are not used to drinking during training, start by taking small mouthfuls as often as possible until you get used to it. Your goal should be to drink 600-1000 ml/hour. It is important to drink before you are thirsty!
- Fluid needs during exercise depend on how intense and long your workout is, weather conditions, and how much you sweat. If you are going to be exercising for more than one hour, then it is recommended that you drink 2-4 cups of water per hour. If you are not exercising for more than one hour, then replace fluids according to your thirst and the weather (more fluid is needed in hotter, more humid climates). Sports drinks, such as Gatorade® or PowerAde® help replace water, carbs, and electrolytes. Avoid sodas and drinks that contain caffeine, because they can actually dehydrate you.
- During training sessions lasting longer than 90 minutes, consuming a carbohydrate electrolyte drink will be advantageous in helping to maintain energy levels and delay fatigue, as well as replacing fluid and mineral losses. Take frequent drink breaks during training. During competition, take advantage of the breaks and drink as much as possible.
- To find the correct balance of fluids for exercise, the American College Of Sports Medicine suggests that "individuals should develop customized fluid replacement programs that prevent excessive (greater than 2 percent body weight reductions from baseline body weight) dehydration. The routine measurement of pre- and post-exercise body weights is useful for determining sweat rates and customized fluid replacement programs. Consumption of beverages containing electrolytes and carbohydrates can help sustain fluid-electrolyte balance and exercise performance."
- According to the Institute of Medicine the need for carbohydrate and electrolytes replacement during exercise depends on exercise intensity, duration, weather and individual differences in sweat rates. [They write, "Fluid replacement beverages might contain ~20–30 meqILj1 sodium (chloride as the anion), ~2–5 meqILj1 potassium and

~5–10% carbohydrate."] Sodium and potassium are to help replace sweat electrolyte losses, and sodium also helps to stimulate thirst. Carbohydrate provides energy for exercise over 60-90 minutes. This can also be provided through energy gels, bars, and other foods.

Events lasting less than one hour:

- Athletes competing in events lasting less than one hour may not have any opportunity to ingest fluid during the event.
- If competition lasts less than 60 minutes, it is recommended that 180 to 240 ml (¾ to 1 cup) of cold water is consumed every 10 to 15 minutes to prevent dehydration.
- Cold water is an excellent choice because it leaves the stomach faster than room temperature water, is absorbed rapidly, and is well tolerated.
- If the athlete has consumed proper amounts of dietary carbohydrate, muscle and liver glycogen stores should be sufficient for optimal performance, and only water needs to be consumed during exercise.

Exercise more than one hour or high-intensity intermittent exercise for one to four hours:

- Athletes engaging in continuous exercise for more than one hour (such as marathon runners) or athletes performing high-intensity intermittent exercise for one to four hours (such as soccer or basketball players) are at risk for hypoglycemia, dehydration, and fatigue, factors known to decrease performance. Since both carbohydrate and fluid are needed, as a practical matter many athletes consume carbohydrate beverages.
- These athletes should consume 150 to 300 ml of a carbohydrate/electrolyte beverage every 15 to 20 minutes during exercise.
- Water in the beverage helps prevent dehydration, and the carbohydrate provides glucose to prevent glycogen depletion. Both dehydration and glycogen depletion hasten the onset of fatigue.
- The electrolyte sodium helps the body retain fluid and stimulates the drive to drink more fluid.
- Water is the best fluid for most people. But during high intensity exercise exceeding 45 minutes, sports drinks may be better to help replace carbohydrates and lost electrolytes.
- Some loss of electrolytes occurs during exercise because sodium and chloride are lost in sweat.

- Water does not have the performance benefits of sport drinks; it merely replenishes fluid, not carbohydrates and minerals. Sports drinks are formulated to be more effective than water when fluid, carbohydrate and electrolyte replacement are necessary.
- Sports drinks also encourage athletes to drink more, which enhances rehydration. Sports drinks can be helpful to athletes who are exercising at a high intensity for 60 minutes or more. Fluids supplying 60 to 100 calories per 8 ounces help to supply the needed calories required for continuous performance. It's really not necessary to replace losses of sodium, potassium and other electrolytes during exercise since you're unlikely to deplete your body's stores of these minerals during normal training. If, however, you find yourself exercising in extreme conditions over 3 or 5 hours (a marathon, Ironman or ultra-marathon, for example) you May likely want to add a complex sports drink with electrolytes.

During exercise, humans typically drink insufficient amounts of fluid to negate water loss from sweat. Without adequate fluid replacement during physical activity, internal body temperature rises along with heart rate, and sweat rates decrease. To minimize the chance of developing heat illnesses, fluid intake should equal sweat rate. This approximates 150 milliliters (4 oz) to 350 milliliters (10 oz) every 15 to 20 minutes of exercise. The best fluid replacement is cool water for physical activities lasting under one hour. When exercising longer than one hour, a sport drink, with less than 10% carbohydrate concentration and less than seven grams of sodium per liter should be consumed. The carbohydrates (Chapter 8) will help maintain blood glucose levels and delay onset of fatigue.

3.5. Sports Drinks

There are three types of sports drink all of which contain various levels of fluid, electrolytes and carbohydrate.

Hypotonic drink

Amounts of sugars and minerals are lower than in body fluids and therefore most rapidly absorbed by the body.

Isotonic drink

Amounts of sugars and minerals are equal to the amounts in body fluids and therefore rapidly absorbed by the body.

Hypertonic drink

Amounts of sugars and minerals are higher than the amounts in body fluids and adopted slower by the body than a hypotonic or isotonic drink. Hypertonic drinks (cola, juice) can cause gastro-intestinal problems.

Type	Content
Isotonic	Fluid, electrolytes and 6 to 8% carbohydrate
Hypotonic	Fluids, electrolytes and a low level of carbohydrate
Hypertonic	High level of carbohydrate

The osmolality of a fluid is a measure of the number of particles in a solution. In a drink, these particles will comprise of carbohydrate, electrolytes, sweeteners and preservatives. In blood plasma the particles will comprise of sodium, proteins and glucose. Blood has an osmolality of 280 to 330mOsm/kg. Drinks with an osmolality of 270 to 330mOsm/kg are said to be in balance with the body's fluid and are called Isotonic. Hypotonic fluids have fewer particles than blood and Hypertonic have more particles than blood.

Consuming fluids with a low osmolality, e.g. water, results in a fall in the blood plasma osmolality and reduces the drive to drink well before sufficient fluid has been consumed to replace losses.

- ❖ Maxim Energy Drink electrolyte has been scientifically developed as a fluid, mineral and energy replacement formula for sports people. It contains the right amount of carbohydrates and minerals to optimize your performance. It is a hypotonic thirst quencher.

The higher the carbohydrate levels in a drink the slower the rate of stomach emptying. Isotonic drinks with a carbohydrate level of between 6 and 8% are emptied from the stomach at a rate similar to water. Electrolytes especially sodium and potassium in a drink will reduce urine output enable the fluid to empty quickly from the stomach promote absorption from the intestine and encourage fluid retention.

Electrolytes

Electrolytes serve three general functions in the body:

- ✓ many are essential minerals
- ✓ they control osmosis of water between body compartments
- ✓ they help maintain the acid-base balance required for normal cellular activities

The electrolyte composition of sweat is variable but comprises of the following components:

- Sodium
- Potassium

- Calcium
- Magnesium
- Chloride
- Bicarbonate
- Phosphate
- Sulphate

A liter of sweat typically contains 0.02g Calcium, 0.05g Magnesium, 1.15g Sodium, 0.23g Potassium and 1.48g Chloride. This composition will vary from person to person.

Which is sporty drink most suitable?

Isotonic - quickly replaces fluids lost by sweating and supplies a boost of carbohydrate. This drink is the choice for most athletes - middle and long distance running or team sports. Glucose is the body's preferred source of energy therefore it may be appropriate to consume Isotonic drinks where the carbohydrate source is glucose in a concentration of 6% to 8% - e.g. High Five, SiS Go, Boots Isotonic, Lucozade Sport.

Hypotonic - quickly replaces fluids lost by sweating. Suitable for athletes who need fluid without the boost of carbohydrate e.g. jockeys and gymnasts

Hypertonic - used to supplement daily carbohydrate intake normally after exercise to top up muscle glycogen stores. In ultra-distance events, high levels of energy are required and hypertonic drinks can be taken during exercise to meet the energy demands. If used during exercise Hypertonic drinks need to be used in conjunction with isotonic drinks to replace fluids.

Sports drinks can be divided in three categories:

Can we make our own sport drink?

- Isotonic - 200ml of orange squash (concentrated orange), 1 liter of water and a pinch of salt (1g). Mix all the ingredients together and keep chilled
- Hypotonic - 100ml of orange squash (concentrated orange), 1 liter of water and a pinch of salt (1g). Mix all the ingredients together and keep chilled.
- Hypertonic - 400ml of orange squash (concentrated orange), 1 liter of water and a pinch of salt (1g). Mix all the ingredients together

Reader Question: How much water should I drink while exercising? Should I be using a sports drink?

Whether you are an athlete in training or just starting a fitness program for the first time keeping your body hydrated is very important to the function of our body's cells and our performance in our sport. When you are thirsty your body is already dehydrated at the cellular level. It is important to drink water throughout the day to keep our hydration levels up. Dark yellow urine is one indication of dehydration whereas a light and clearer color shows a hydrated body. With many fitness events/races and opportunities for senior athletes coming up the following information is a guideline for fluid intake before, during and after training and/or competition. **The longer and more intensely you exercise, the more important it is to drink the right kind of fluids.**

Fluids to avoid during exercise

During exercise, avoid drinks too high in carbohydrates (sugars). This includes sodas, fruit juices, sweetened ice teas and lemonade. The extra carbs can cause cramping, gas and/or diarrhea. They can also prevent absorption of fluid into the bloodstream.

Look for solutions that have about 6 percent to 8 percent carbohydrate (the amount in most sports drinks). Other considerations:

- Contrary to popular belief, evidence suggests that moderate caffeine intake does not affect exercise or fluid status.
- Alcohol: Avoid alcohol before, during and directly after a workout. It can interfere with muscle recovery and affect your performance.

3.6. Hydration after Exercise

Objectives

- To replace any lost fluids and electrolytes during exercise.

Guidelines

Immediately after the completion of the exercise activity and during the cool-down period, rehydration should begin. Any type of fluid is acceptable as long as it does not contain caffeine or alcohol. Both of these drugs are diuretics and defeat the rehydration effort. If a person is a competitive athlete, the rehydration fluid should contain carbohydrates to help replenish the depleted skeletal muscle glycogen stores.

- ❖ Athletes who have exercised intensely for an hour or longer are likely to experience some degree of under hydration. For those athletes who exercise most days (i.e., most elite athletes), post exercise fluid consumption becomes a critically important part of the exercise regimen because it helps the athlete begin each subsequent day of activity in a well-hydrated state. The important point to consider is this: It takes time to dehydrate. The less time there is to dehydrate, the lower the likelihood that the athlete will be optimally hydrated by the beginning of the next exercise session.
- ❖ Athletes rarely consume fluids during exercise at a rate of more than 70 percent of sweat loss, and most athletes replace sweat losses at a rate significantly lower than this. Therefore, most athletes require strategies to achieve adequate hydration before the next

exercise session begins. Despite this clear need for fluids, athletes often remain under hydrated even when fluids are readily available to them. This voluntary dehydration suggests that athletes should be placed on a fixed fluid-replacement schedule that will increase the likelihood of maintaining hydration. A way of encouraging this is to make certain that cool, good-tasting fluids are easily available to the athlete as soon as the exercise session is over.

- Sports drinks containing both carbohydrate and sodium are more effective than plain water at restoring water balance. To maximize dehydration, however, it appears that a level of sodium greater than that provided in most sports drinks is desirable. This added sodium can be obtained through the normal consumption of foods, many of which have added salt (sodium).
- Aim to drink within 30 minutes of working out.
- Your fluid replacement needs will be higher after endurance or high intensity activities. Check with your doctor for more information.
- Immediately after exercise and for the next six to eight hours, rehydration is imperative so athletes do not begin the next training session or competition in a compromised state.
- After exercise, sodium is beneficial because its presence influences the body to retain fluid and helps to maintain the drive to drink.
- Sodium and water are found in sports beverages, but the amount of sodium is low. In general after exercise, athletes could also lightly salt their food.
- Weigh yourself before exercise and then again after, for every pound lost drink a pint and a half (three cups) per pound lost. This is a minimum.
- Studies have shown that athletes do not voluntarily rehydrate after exercise. They need to have a plan to replenish fluid lost during exercise.
- Fluid consumption (and carbohydrate consumption) should continue for at least the next four to six hours.
- A large volume of fluid (as much as can be tolerated, perhaps .5 liter) should be consumed immediately after exercise. This large fluid volume enlarges the stomach and increases the rate at which fluids leave the stomach and enter the small intestine to be absorbed.
- After the initial consumption of a large fluid volume, athletes should consume approximately 1/4 liter of fluid every 15 minutes to achieve a fluid intake of approximately 3 liters of fluid in 3 hours. The larger the athlete and the greater the sweat loss experienced during activity, the greater the amount of fluid that must be consumed.

- ❖ Fluids should contain both carbohydrate and sodium because both are useful in returning the athlete to a well-hydrated state. In addition, the carbohydrate content of the beverage helps in returning stored glycogen (energy) to muscles in preparation for the next exercise session.
- ❖ Sports drinks typically provide approximately 10 to 25 mill-moles of electrolytes (mainly sodium) per liter of fluid. However, the optimal sodium concentration for fluid retention is approximately 50 milli-moles of electrolytes per liter of fluid. Since adding more sodium to fluids may make the fluid unpalatable and cause the athlete to consume less fluid, the athlete should be encouraged to consume some salted snacks (such as pretzels or saltine crackers) during the period immediately after exercise.
- ❖ The loss in body weight that results from exercise should be the key to determining the total amount of fluid that must be replaced before the next exercise session. As a general guide, 1 pint (16 ounces) of retained fluid is equal to 1 pound of body weight. Since not all consumed water is retained, twice as much fluid may need to be consumed to replace the fluid equivalent in weight loss.
- ❖ Fluids containing caffeine and related substances (coffee, tea, colas and chocolate) should be avoided because they increase urinary water loss.

In general the best way to determine how much to drink (either water of a sports drink) is to:

- Weigh yourself before and after exercise and replace fluid losses.
- Drink 20-24 fl oz water for every 1 lb lost.
- Consume a 4:1 ratio of carbohydrate to protein within the 2 hours after exercise to replenish glycogen stores.
- Drink 16 ounces (2 cups) and return to normal eating and drinking patterns. Calorie containing drinks (like juice or a sports drink) can replace water and glucose. You can figure out if you are well hydrated by looking at the color of your urine. A clear color is a sign of good hydration. However, if you see a darker yellow color, this means that you need to drink more fluids.

Alcohol

Alcohol is a high octane fuel but it cannot be metabolized to provide energy except in the liver and then only at a very slow rate. Energy provided by alcohol tends to be converted to fat and excessive consumption may cause liver damage. As a diuretic it will cause dehydration and evidence suggests that vitamin B and C may be depleted. Excessive alcohol will diminish aerobic capacity and impair motor function.

CHPTER FOUR

4. NUTRITION REQUIREMENT FOR EXERCISE

INTRODUCTION

The goal of competition nutrition strategies is to combat factors that would otherwise cause fatigue or loss of performance during an event. Factors that can stop the athlete from performing optimally include depletion of glycogen stores in the active muscle, hypoglycemia (low levels of blood glucose) and other mechanisms of "central fatigue" involving neurotransmitters, hyperthermia, dehydration, hyponatremia (low levels of blood sodium), and gastrointestinal discomfort and upset. These factors vary according to the duration and intensity of the exercise, the environmental conditions, and the athlete's individual characteristics including their nutritional and training status. Competition nutrition includes special eating strategies undertaken before, during, and in the recovery from the event. In this chapter we will review the strategies undertaken in the hours or days prior to competition to prepare the athlete to perform at his or her best. Ideally, these will form part of a total nutrition plan that is developed to meet the challenges of the event within the practical opportunities provided to the athlete.

Objectives

At the end of this chapter, you will be able to:

- Understand the effects of improper pre-event meals
- Identify which meals are taken before, during and after exercise or competition
- Mention the importance of post-work out recovery
- List basic guidelines for proper pre-event meals

4.1. Nutrition before Exercise

Food consumed before and between athletic events can have significant impact on an individual's ability to perform. Many people have their own ideas about what foods to consume around athletic events. Some of these ideas may be good. However, many foods consumed by athletes before and between events are inappropriate and may harm the athlete's performance. This publication outlines the proper aspects of eating close to performance time.

Body Functions

A basic understanding of certain bodily functions can be helpful in learning the important components of a good pre-event meal.

Digestion: Athletic performance will be better if virtually no food is in the stomach or small intestines at the time the event is being performed. All food must be digested in the stomach and small intestines before being absorbed into the body and, thus, clear the gastrointestinal tract. However, the time needed for digestion varies due to factors such as the carbohydrate, fat, and protein content of the meal as well as the size of the meal. For example, carbohydrates are relatively easy to digest. Carbohydrates can generally be digested and absorbed in about three to four hours. However, fat and protein require a much longer time, approximately five to seven hours, to digest and absorb. The size of the meal also can influence the overall time needed for digestion and absorption. Large meals may require many hours to clear the gastrointestinal tract, whereas, smaller meals may be digested in just a couple of hours. Nervousness often associated with athletic events also can impair normal digestion and absorption of food.

Blood Supply: An average- size adult will have about five quarts of blood circulating throughout the body. Children have less, the amount depending on the size of the child.

Following ingestion of a meal, blood will be diverted from areas of the body with low needs to the stomach and intestinal area. This extra blood helps the processes of digestion and absorption of the food that has been eaten. During exercise, large amounts of blood are diverted to the working muscles and to the skin for sweat production and cooling. In this process blood is actually shunted away from the gastrointestinal tract. Thus, digestion and absorption of food can be impaired during exercise because the digestive system receives less blood instead of more.

Therefore, it is advantageous to the athlete to have the digestive and absorptive processes virtually complete by the time exercise starts. There should be little or no food in the stomach and small intestine at the time of exercise.

Liver Carbohydrate: The liver is capable of storing carbohydrate (called glycogen). This liver carbohydrate can be released to the blood and is a major source of blood glucose (blood sugar). If the blood glucose concentration drops too low, working muscle and brain, which rely on the glucose for energy, can be deprived of this fuel source and not function properly. This would be detrimental to the person who is exercising. The liver can store enough carbohydrate to supply the brain and resting muscles for about 12 to 15 hours. Working muscle will use up liver carbohydrate much faster. Thus, making sure liver carbohydrate stores are at maximum levels would be important for an athlete about to enter an event.

Components of a Good Pre-Event Meal

Activity 4.1

1. What we should consider when proper pre-event meals have been developed?
2. What are the basic components of proper pre-event meals?

Certain components of a proper pre-event meal can be important to performance. The meal should clear the gastrointestinal tract by the time the event starts. The meal should be able to enhance liver carbohydrate stores, and the meal should help support hydration in the athlete.

Basic guidelines for proper pre-event meals have been developed

Timing: Because virtually all food should be cleared from the gastrointestinal tract prior to exercise, timing of the meal becomes an important issue. Pre event meals should be consumed from 2 to 4 hours before exercise. This allows ample time for a proper pre-event meal to be cleared. If the meal is consumed longer than 4 hours before the event, then the athlete may become hungry. Foods eaten less than 2 hours before exercise may not have time to be digested and absorbed. This can actually hurt performance.

Composition of the meal: Carbohydrate foods clear the stomach and small intestines faster than high protein or high fat foods. Thus, pre-event meals should consist primarily of high carbohydrate-type foods. Small amounts of protein and fat are acceptable. Examples of good high carbohydrate foods to be used in pre-event nutrition can be found in Table 2. Items such as breads, cereals, pasta, pancakes, rice, fruits and fruit juices, and low fat yogurt are all examples of foods that could be used in a pre-event meal. Foods such as steaks, eggs, french fries, hamburgers, hot dogs, nuts, and bacon are high in fat or protein and should be minimized meals eaten before competition.

Bland foods: Foods eaten before competition generally should be somewhat bland in taste. Spicy foods with pepper or chili powder and foods such as onions, cabbage, broccoli, and beans should be avoided. These foods tend to stimulate the gastrointestinal tract, produce gas, and could cause problems when eaten before athletic events. While a small amount of a carbonated beverage is probably acceptable, consumption of large quantities of these beverages should be avoided due to possible gas production.

Components of a Good Pre-Event Meal

- The meal should be consumed 2 to 4 hours before the event.
- The meal should be high in carbohydrate content with small amounts of fat and protein.
- Generally, foods should be somewhat bland. Spicy, gas-producing, and other irritating foods should be avoided.
- The meal should be low in dietary fiber.
- The meal should be small in size—less than 1,000 calories.
- Dilute, non-caffeinated drinks should be consumed. Alcoholic beverages should be avoided.

Dietary fiber: Normally, it would be a good practice to include foods with ample dietary fiber in one’s diet. However, some types of dietary fiber can stimulate defecation and having to go to the bathroom during an athletic event is not advantageous. Foods high in fiber, such as beans, various types of bran, nuts, and raw vegetables, should be minimized during the hours or day prior to a major competition.

Meal size: As previously mentioned, large meals take a long time to be digested and absorbed. Large meals eaten the day before an athletic event would be acceptable; however, large meals should not be consumed on the day of an event, before the competition. Consumption of large pre-event meals will virtually guarantee that food will still be in the stomach and small intestines at the time of competition. This can cause minor to serious discomfort for the athlete. It is recommended that pre-event meals not exceed 1,000 calories. Often the meal may be only 500 to 600 calories.

Beverages: The consumption of ample quantities of fluid in the hours before competition is encouraged. This will insure that the athlete does not go into the event in a dehydrated state. Beverages such as low fat or skim milk or fruit juices can be consumed up 2 hours before the event. Water and sports drinks should be consumed 2 hours or less before the start of the event. Consumption of carbonated beverages should be minimized in the pre-event period as these types of beverages may result in excessive belching and stomach discomfort before exercise. Consumption of caffeine-containing beverages such as coffee, tea, and cola also should be avoided during this time. Caffeine has a diuretic action that can increase urine output and possibly contribute to dehydration. Caffeine consumption also can increase the frequency of defecation. Alcoholic beverages should be avoided. Alcohol has a diuretic action similar to caffeine. In addition, alcohol consumption beyond minimal amounts can have adverse effects on performance.

Adverse Symptoms of an Improper Pre-Event Meal

Nausea	Vomiting
Intestinal cramps	Flatulence
Belching	Diarrhea or the urge to defecate
Low blood sugar	Dehydration

Adverse Effects of Improper Pre-Event Meals

Improper pre-event nutrition can harm the athlete in several ways. If meals before competition are taken too far in advance or are low in carbohydrates, then the athlete could go into the event feeling hungry and perhaps with blood sugar values that are lower than optimum. Low fluid consumption in the hours before an event can result in the athlete's being dehydrated. This would adversely influence performance, especially on hot, humid days. Most adverse effects of pre event meals are associated with food still remaining in the stomach and intestines when physical activity begins. This food can cause numerous gastrointestinal problems as outlined in the above.

All of these side effects could cause the athlete to perform less than optimally. Even if symptoms are not severe, the athlete's performance is probably being compromised.

The pre-event meal (1–4 hours pre-event)

The goals of the pre-event meal are to:

1. Continues to fuel muscle glycogen stores if they have not been fully restored or loaded since the last exercise session;
2. Restore liver glycogen content, especially for events undertaken in the morning where liver stores are depleted from an overnight fast;
3. Ensure that the athlete is well hydrated;
4. Prevent hunger, yet avoid the gastrointestinal discomfort and upset often experienced during exercise

When should I eat?

Food consumed before exercise is only useful once it has been digested and absorbed. This means you need to time your food intake so that the fuel becomes available during the exercise period. The time required for digestion depends on the type and quantity of food consumed. Generally, foods higher in fat, protein and fiber tend to take longer to digest than other foods, and may increase the risk of stomach discomfort during exercise. Large quantities of foods take longer to digest than smaller quantities. You need to experiment to find the timing that best suits your individual needs. Generally, tolerance is better during lower intensity activities or sports where the body is supported (e.g. swimming, cycling) than sports such as running where the gut is jostled about during exercise. A general guide is to have a meal about 3-4 hours before exercise or a lighter snack about 1-2 hours before exercise.

What should I eat?

Food eaten before exercise should provide carbohydrate. It should also be low in fat and moderate in fiber to aid digestion and reduce the risk of gastrointestinal discomfort or upsets. On occasions, it may be important to place emphasis pre-event on intake of carbohydrate and fluid. However, it is also useful to continue to consider other nutritional goals when choosing a pre exercise meal. This means opting for meals that provide a wide variety of nutrients including protein, vitamins and minerals.

Sample of Pre-Exercise Foods

3 to 4 hours before competition

- Fresh fruit
- Bread, bagels –
- Pasta with tomato sauce
- Baked potatoes

- Energy bar
- Cereal with milk
- Yogurt
- Bread with a bit of peanut butter, lean meat, or cheese
- Water

2 to 3 hours before competition

- Fresh fruits
- Bread, bagels, pasta
- Yogurt
- Water

The following snacks are suitable to eat 1-2 hours before exercise:

- Liquid meal supplement
- Fruit smoothie
- sports bars (check labels for carbohydrate and protein content)
- Breakfast cereal with milk
- Cereal bars
- Fruit

1 hour or less before competition

- Fresh fruit such as apples, watermelon, peaches, grapes, or oranges and/or
- Energy gels up to 1 1/2 cups of a sports drink.
- Carbohydrate gel

Foods to Avoid Before Exercise

Any foods with a lot of fat can be very difficult and slow to digest and remain in the stomach a long time. They also will pull blood into the stomach to aid in digestion, which can cause cramping and discomfort. Meats, doughnuts, fries, potato chips, and candy bars should be avoided in a pre-exercise meal.

Keep in mind that everyone is a bit different and what works for you may not work for you teammate or training partner. Factor in individual preferences and favorite foods, and an eating plan is a highly individualize thing.

4.2. Nutrition during Exercise

Activity 4.2

1. Describe the objectives of eating during exercise/competition?

2. Explain the Gastrointestinal disturbances during exercise?

Ingestion of food and fluid during exercise has the potential to improve performance by influencing one or more of the factors that limit exercise performance. Prolonged hard exercise is associated with an increased body temperature, a decrease in body water content due to sweat loss, and a fall in the body's liver and muscle carbohydrate (CHO) stores. All of these factors can impair performance by reducing exercise capacity and, in some circumstances, by bringing about impairment of skilled movements and of decision making. Ingestion of CHO and fluids before and during competition can improve performance, but athletes prone to gastrointestinal problems often avoid any solid or liquid intake for some hours before, and also during, competition.

Eating Between Events

Many athletes may have to perform several times during a day. Multiple matches in tennis and two or three soccer games in a day are not unusual. Guidelines for eating between these events generally are not different from those previously discussed for pre-event meals. This is especially true if there are at least 2 hours between events. The time between events meal then becomes a prevent meal. Often the time between events is less than 2 hours. In these cases a full meal cannot be consumed. Instead, a small, high-carbohydrate snack will need to be consumed along with adequate fluid intake from sports drinks and water.. Generally, in these situations the athlete would not want to consume more than about 300 calories. The main focus is to keep the athlete hydrated and not feeling hungry, yet still leave the gastrointestinal tract empty when competition begins.

Objectives

- To refuel your glycogen stores and replenish your fluid losses. A decrease in one and/or the other stock leads to a diminished performance

- To improve performance in a competition, and also to lift work rate, or the ability to do the given work load during a training session.
- Consuming food especially carbohydrate during exercise are to firstly keep blood glucose levels high during prolonged moderate-high intensity events.
- Increase blood glucose provides an alternative fuel source for the muscle when glycogen storage levels are getting low.
- To provides a fuel source for the brain to maintain skills and decision making, and reduce the perception of fatigue.
- To prevent dehydration

Electrolyte composition and concentration

The available evidence indicates that the only electrolyte that should be added to drinks consumed during exercise is sodium, which may be added in the form of sodium chloride or sodium citrate (the latter helps regulate the acidity of the drink). Sodium will stimulate sugar and water uptake in the small intestine and will help to maintain extracellular fluid volume. The optimum sodium concentration is unclear, and equilibration may occur so rapidly in the upper part of the small intestine that addition of high concentrations of sodium is not necessary. Most soft drinks of the cola or lemonade variety contain virtually no sodium (1–2 mmol·l–1), but sports drinks commonly contain about 10–30 mmol·l–1 sodium.

A high sodium content may stimulate absorption of glucose and water in the upper part of the small intestine, but too much can make drinks unpalatable. Drinks intended for ingestion during or after exercise should have pleasant taste in order to stimulate consumption. Specialist sports drinks are generally formulated to strike a balance between the twin aims of efficacy and palatability.

Between-Events Snack Foods

Oatmeal raisin cookies	Fig/Apple/Strawberry
Graham crackers	Saltine crackers
Pretzels	Low fat yogurt
Animal crackers	Raisins
Bread	Bananas
canned peaches	Applesauce
Low fat puddings	Pop tarts
Vanilla wafers	Sports drinks

Sample meals during Exercise

 800ml sports drink

 500ml cola drink

 Liquid meal supplement

 3 small or 2 large bananas

 80g jelly babies or jelly beans

 1 round jam/jelly sandwiches

 Mixing no more than 4 teaspoon of sugar, 1/4 teaspoon of salt and some flavoring (like a teaspoon of lemon juice/ tablespoon of fruit squash) in 8 ounces of water can make a reasonably effective sports drink you can create at home.

Gastrointestinal disturbances during exercise

Disturbances of both the upper and lower gastrointestinal tract may occur during exercise, with problems including reflux, burping, gastritis, and vomiting (upper), and cramp, irritable bowel, and diarrhea (lower). These problems not only cause distress or embarrassment to the athlete, but may exacerbate the performance and health impairments caused by dehydration or low carbohydrate availability during exercise. After all, symptoms such as vomiting and diarrhea cause the further loss of fluids and electrolytes from the body, as well as impeding the potential for replacement of fluid, electrolytes, and carbohydrate during the exercise session. Exercise can be a direct cause of gastrointestinal problems or it may simply exacerbate underlying problems in individual athletes. Factors that seem to be involved in the development of problems include high-intensity exercise, exercise involving "joggling" of the gut (e.g. running), moderate to severe levels of dehydration, and the intake of inappropriate amounts or types of foods and fluids before or during exercise. Dietary factors that can be modified include the timing and volume of food consumed before exercise, and the presence of large amounts of fiber, fat, protein, fructose, or lactose in pre-event meals. Factors that may cause problems during exercise include dehydration (i.e. waiting too long before attempting to replace fluids during the session), and the intake of fluids or foods that are too highly concentrated, or have an excessive amount of fructose or fiber. Females appear to be at greater risk of gut disturbances, and training appears to reduce the frequency of symptoms. Athletes who experience gut problems should seek the advice of a sports doctor, and be prepared to experiment with their pre-event and during-event nutrition strategies.

4.3. Nutrition after Exercise

Activity 4.3

1. What are the guidelines of food intake after exercise/competition?
2. What are the benefits of eating meals post exercise?

After endurance exercise, the carbohydrate stores in the liver and muscles are depleted and need to be replaced before the next bout of exercise. If glycogen stores have become fully depleted, it may take up to 48 hours for the stores to become fully replete and even longer if the diet is low in carbohydrate. The most rapid rate of re-synthesis is during the first one or two hours after exercise, when the enzymes in the body are most receptive to converting carbohydrate to glycogen. During this period it is vital that plenty of carbohydrates are consumed, which can be either in solid or in liquid carbohydrate form. Clear evidence of the value of carbohydrates in improving recovery came from a recent study at Loughborough University in England, which involved two groups of subjects running to exhaustion on a treadmill at a constant speed.

After the run, one group consumed a high carbohydrate diet for 24 hours, whilst the second group consumed a 'normal' diet. Both groups then repeated the run. The group on the 'normal' diet ran for only 71 minutes on their second run, compared to 86 minutes on their first run. In contrast, the group on the high carbohydrate diet ran for 83 minutes on their first run and for 92 minutes on their second run, an improvement of 9 minutes. This shows that even after a relatively short period of time, consumption of a high carbohydrate diet results in an enhanced rate of recovery.

The ability to recover after exercise is vital in all sports, and does not just involve recovery from or for competitions. Most top level sports people expend as much if not more energy when training as they do when competing, so it is vital that carbohydrates are also consumed to support the energy demands of training. Individuals in sports such as athletics and swimming often only have to 'peak' for one or two major events each season. In contrast, for many team sports, each match is equally important, and many matches are played in a short space of time. Recovery time is therefore limited, so the consumption of a correct diet is crucial. Team sport competitors should start preparing for their next match as soon as they are off the field of play following the preceding match. The first stage of this recovery should be the replacement of the body's carbohydrate and fluid stores.

Post-workout Recovery

- Goal: Restore the body’s fuel lost during exercise
- Snack should be eaten within 30 minutes
- Meal should be eaten within 2 hours

Post-workout Food

- 4:1 Ratio carbohydrate to protein
- Carbohydrates replace muscle stores
- Protein helps repair damaged muscle tissue and generate new muscle growth

Post-workout Beverage

- 16-24oz of water or sports drink for every pound lost during exercise Weigh before and after a workout
- Replace fluid and electrolyte lost in sweat

Post-workout Recovery

- If you are not hungry after a workout, go for a fluid source of fuel Chocolate milk
- Smoothie made with fruit and yogurt
- Sports drink

Snack Ideas

- Chocolate milk
- Whole wheat English muffin with an egg or piece of melted cheese
- Oatmeal made with milk and nuts
- Trail mix and sports drink
- Whole piece of fruit (apple, orange, and banana) and cheese stick

Recovery encompasses a complex range of Nutrition-related issues including:

- Restoration of muscle and liver glycogen stores;
- Replacement of fluid and electrolytes lost in sweat; and

 Regeneration, repair, and adaptation processes following the catabolic stress and damage caused by the exercise.

Objectives

- To refuel your body after a hard workout. Because your body replaces glycogen stores in your muscle within the first few hours after exercise.
- To replace carbohydrate, water and electrolytes that we lost in training and competition.
- For aiding recovery from exercise and maintaining the ability to train the following days.

Guidelines

- The basic rules here are really very simple, and when followed, will most certainly ensure you get the best health benefits from your exercise.
- Whatever form it may take, by preparing your body properly and ensuring it has the required elements to maximize recovery and improvement afterwards.
- It is important to eat carbohydrate and protein soon after workout.
- If the exercise was strenuous and lasted a long time, glycogen stores may well need refueling.
- Consuming foods and beverages high in carbohydrates right after exercise will certainly replenish glycogen stores if they have become low after exercising.
- But no matter how intense the exercise was its very important to then drink plenty of water and eat a meal that contains lots of carbohydrate rich foods such as grains, pastas, potatoes, vegetables and fruits.
- A teaspoon of sugar, (at only 15 calories per teaspoon), adds flavor to these foods and may increase the appeal to your taste buds, but you should remember that like all carbohydrates, sugar has 4 calories per gram and there are 4 grams to a teaspoon.
- Most athletes know of the importance of eating before exercise, however, what and when you eat after exercise can be just as important. While the pre-exercise meal can ensure that adequate glycogen stores are available for optimal performance (glycogen is the source of energy most often used for exercise) and also the post-exercise meal is critical to recovery and improves your ability to train consistently.
- Research shows that combining protein with carbohydrate in the two hours after exercise nearly doubles the insulin response, which results in more stored glycogen. The optimal carbohydrate to protein ratio for this effect is 4:1 (four grams of carbohydrate for every one gram of protein). Eating more protein than that, however, has a negative impact because it slows rehydration and glycogen replenishment.

- One study found that athletes who refueled with carbohydrate and protein had 100 percent greater muscle glycogen stores than those who only ate carbohydrate. Insulin was also highest in those who consumed a carbohydrate and protein drink.

Even if you aren't hungry, you should eat a snack that contains carbohydrates within 30 minutes after your workout (such as a yogurt or half a sandwich). This will help your body recover quickly. Fluid, carbohydrate, and protein intake after exercise is critical, especially after heavy exercise. Delaying the ingestion of carbohydrates by several hours slows down the rate at which the body is able to store glycogen. For the casual exerciser, this means packing a piece of fruit, fruit juice, or a fluid replacement beverage for a post-workout snack, and then eating a mixed high carbohydrate and protein meal (such as pasta with lentil spaghetti sauce or tofu, vegetables, and rice) shortly thereafter. For the heavily training endurance athlete, a meal containing both a good source of protein and 100 grams of carbohydrate is recommended, followed by additional carbohydrate feedings every 2 to 4 hours.

CHAPTER FIVE

5. EATING DISORDER IN ATHLETES

Objectives

At the end of this chapter, you will be able to:

- ❖ Understand eating disorder
- ❖ Know the causes of eating disorder
- ❖ Identify and help athletes with eating disorder

Eating disorders: - refer to a group of conditions characterized by abnormal eating habits that may involve either insufficient or excessive food intake to the detriment of an individual's physical and emotional health. Problems with body weight and weight control are not limited to excessive body fat. A growing number of people, especially adolescent girls and young women, experienced eating disorder.

Eating disorder is a serious disturbance in eating pattern or eating-related behavior characterized by a negative body image and concern about body weight or body fat.

Two eating disorders

- ❖ Anorexia nervosa
- ❖ Bulimia nervosa

Anorexia nervosa: - is an eating disorder in which a person abnormally restricted his/her calories intake. People with this disorder believe that they are overweight, even though they appear very lean and develop malnutrition and loss of important fluid in extreme case the disease can result in death because of this they need medical help.

Some common signs or symptoms of a person who is at risk of developing Anorexia nervosa are as follows:

1. Sudden large weight loss.
2. Preoccupation with food, calories and weight.
3. Choice of baggy or layered clothing.
4. Mood swings
5. Consuming of minimal amount of food in front of others.

Bulimia nervosa: - is an eating disorder in which a people over eat and then force themselves to vomit after wards, or they purposely over use laxative to eliminate food from their bodies. Bulimia nervosa can cause negative long-term health effect. Some common signs or symptoms of a person who is at risk of developing Bulimia nervosa are as follows:

1. Noticeable weight loss or gain.
2. Excessive concern about weight.

3. Depressed moods.
4. Habit of visiting the bathroom immediately after meals (to induced vomiting).
5. Strict dieting followed by eating binges.

Some guidelines for eating

- Eat regularly
- Keep a record of what, where, when, and how much you are eating.
- Reward yourselves when you accomplished anew positive behavior or habits and achieve your goals.

5.1. How to Identify an Athlete with Anorexia Nervosa or Bulimia

Being "skinny" does not necessarily mean one has anorexia nervosa, just as being ideal weight does not necessarily mean one is healthy. An athlete with anorexia nervosa of bulimia may continue to perform well for a longer-than-expected period of time due to sheer determination combined with the body's remarkable ability to adapt to adverse circumstances. Dieting, weight loss, and pre-event diet rituals do not mean an athlete has anorexia nervosa or bulimia. However, if the following signs or behaviors appear, there is need to pay attention.

- Repeated comments about being or feeling fat and questions such as "Do you think I'm fat?" When weight is below average.
- Weight loss below ideal competitive weight set for that athlete and which continues even during off season.
- Secretive eating, perhaps noted by food wrappers in room or locker, or sneaking food from training table.
- Repeated disappearing immediately after eating, especially if a substantial amount of food was eaten.
- Apparent nervousness or agitation if something prevents ability to be alone shortly after eating.
- Bloodshot eyes, especially after being in the bathroom or any other place where vomiting could have occurred.
- Vomitus odor or vomit in toilet, sink, shower, or wastebasket.
- Extreme weight fluctuations
- Complaints or evidence of bloating or water retention not explained by premenstrual edema (in females) or other known medical conditions.
- Frequent complaints of constipation.
- Lightheadedness, disequilibrium (loss of balance), mood swing not accounted for by other known medical causes.
- Avoiding situations where the athlete would be observed eating.

For example, scheduling other activities at mealtimes, refusing to eat at training table or with teammates on road trips, this may be disguised by an extreme interest in the eating habits of others.

- Purposeless, excessive physical activity that is not part of the training regimen.

How Do You Help an Athlete with Anorexia or Bulimia?

Identify behaviors which suggest an athlete has an eating disorder. Be accessible to teammates who may be concerned and searching for a way to help. Avoid labeling the athlete as anorexic or bulimic.

Do not attempt to diagnose or treat athletes with anorexia or bulimia. An eating disorder is a very complex problem. Help the athlete identify and contact an eating disorders specialist for professional screening. If the athlete denies the problem, but the evidence appears conclusive, consult a trained clinician and review the situation.

If you think an athlete has an eating disorder, you will have to confront the athlete. Focus on the evidence and what the athlete is able to tell you regarding her or his feelings. Talk about fears the athlete may have about being removed from the team or losing a scholarship.

An eating disorder is both a psychological and physiological problem. Diagnosis should be made by a physician, psychologist, and nutritionist trained in eating disorders.

10 Things Coaches Can Do to Help Prevent Eating Disorders in Their Athletes

A. Instruct coaches and trainers to recognize the signs and symptoms of eating disorders and understand their role in helping to prevent them. Those with eating problems often hide their symptoms to avoid calling attention to them. They are often aware the behavior is abnormal.

B. Provide athletes with accurate information regarding weight, loss, body composition, and nutrition and sports performance in order to reduce misinformation and to challenge practices that are unhealthy and even counterproductive. Be aware of local professionals who will help educate the athletes.

C. Emphasize the health risks of low weight, especially for female athletes with menstrual irregularities or amenorrhea. The athlete should be referred for medical assessment in these cases.

D. Refer to a sports psychologist or therapist skilled at treating disorders if an athlete is chronically dieting and/or exhibits mildly abnormal eating. Early detection increases the likelihood of successful treatment -- left untreated; the problem may progress to an eating disorder.

E. De-emphasize weight by not weighing athletes and by minimizing (eliminating) comments about weight. Instead, focus on other areas in which athletes have more control in order to improve performance, i.e. focus on strength and physical conditioning, as well as the mental and emotional components of performance. (There is no risk in improving mental and emotional capacities!)

F. Do no assume that reducing body fat or weight will enhance performance. While weight loss or a reduction in body fat can lead to improved performance, studies show this does not apply to all athletes. Additionally, many individuals respond to weight loss attempts with eating disorder symptoms. Improved performance should not be at the expense of the athlete's health.

G. Understand why weight is such a sensitive and personal issue for many women. Since weight is emotionally charged for many, eliminate derogatory comments or behaviors, no matter how slight, about weight, if there is concern about an athlete's weight, the athlete should be referred for an assessment to a Registered Dietitian and Sports Psychologist skilled in treating eating disorders.

H. Do not automatically curtail athletic participation if an athlete is found to have eating problems, unless warranted by a medical condition. Consider the athlete's health, physical and emotional safety and self-image when making decisions regarding an athlete's level of participation in his/her sport.

I. Sport personnel should explore their own values and attitude regarding weight, dieting and body image, and how these values and attitudes may inadvertently affect their athletes. They should understand their role in promoting a positive self-image and self-esteem in their athletes.

J. Take warning signs seriously. Take eating disorder behaviors seriously. There is a 10-15% mortality and 25% suicide rate for those with eating disorders.