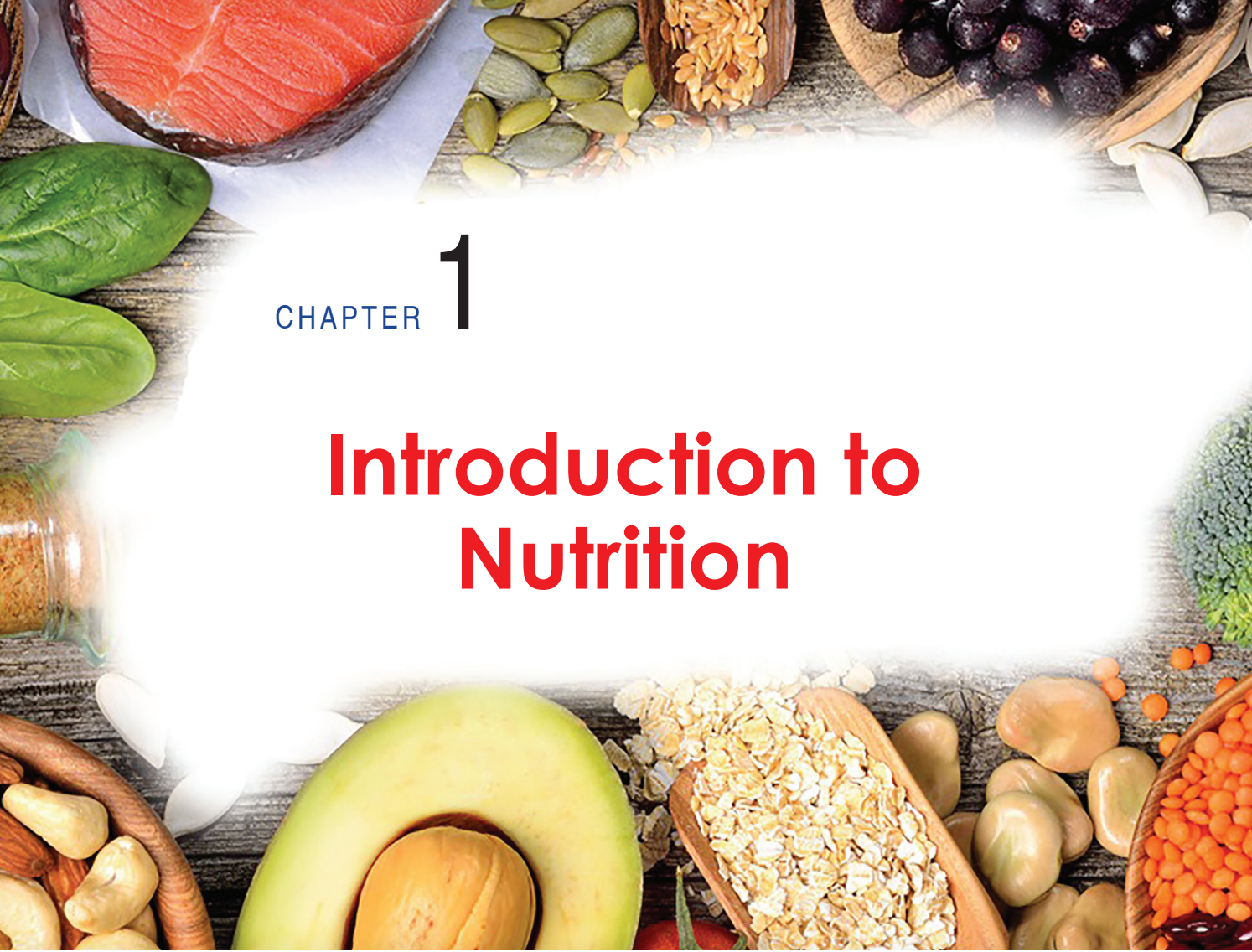




CHAPTER 1

Introduction to Nutrition

LEARNING OBJECTIVE

Define nutrition and its relationship to health

CHAPTER OUTLINE

Concepts

- ♦ Terminology of Nutrition
- ♦ History of Nutrition
- ♦ Concepts of Nutrition
- ♦ Importance of Food in Health and Disease
- ♦ Role of Nutrition in Maintaining Health
- ♦ Factors Affecting Food and Nutrition
- ♦ Malnutrition
- ♦ Role of Food and its Medicinal Value

Nutrients

- ♦ Classification of Nutrients
- ♦ Macronutrients and Micronutrients

Contd...

- ♦ Organic and Inorganic Nutrients
- ♦ Energy Yielding and Non-energy Yielding Nutrients

Food

- ♦ Origin of Food
- ♦ Food Groups

KEY TERMS

- ♦ **BMR (Poor nutrition):** The basal metabolic rate (BMR) is the measurement of an organism's energy expenditure when at rest. Amount of minimum energy required to carry on the basic involuntary work of the body is known as BMR.
- ♦ **Carbohydrates:** The organic compounds, sugar, starches and dietary fiber that occur in plant foods and provide energy to body.
- ♦ **Dietetics:** Practical applications of the principles of nutrition, including the planning of meals for well and sick.
- ♦ **Energy:** Capacity to do work.
- ♦ **Food taboos:** Religion-based food habits like vegetarianism in Hindu society and prohibition of pork in Muslim society.
- ♦ **Health:** State of complete physical, mental and social well-being and not merely an absence of disease and infirmity (WHO).
- ♦ **Lipid:** A small water insoluble biomolecule generally containing fatty acids, sterols or isoprenoid compounds.
- ♦ **Macronutrients:** Required in large quantity and from the bulk of our food, e.g., proteins, fats and carbohydrates.
- ♦ **Malnutrition:** Impairment of health resulting from a deficiency, excess or imbalance of nutrients.
- ♦ **Micronutrients:** Required in small amounts but play an important role in the regulation of metabolic activities, e.g., vitamins and minerals.
- ♦ **Nutrient:** A substance essential for the growth, maintenance, function and reproduction of a cell or of an organism.
- ♦ **Nutrition:** The science of food and its relationship to health.
- ♦ **Protein:** A macromolecule composed of one or more polypeptide chains, each with a characteristic sequence of amino acids linked by peptide bonds and is essential for muscle mass.
- ♦ **Vitamin:** An organic substance required in small quantities in the diet that generally functions as a component of a coenzyme.

INTRODUCTION

In ancient times, even before the dawn of civilization, human beings believed in live to eat or eat to live notion, because probably, these were the first and fundamental lessons they could learn from the experience of existence and survival. According to *Maharshi Charaka*, the sage and physician of ancient times, emphatically observed: "The body is the outcome of the food", the distinction between ease and disease arising, totally or partially, due to faulty food or diet" thus laying down the bedrock of foods, nutrition and health relationship.

The study of how food nourishes the body is nutrition. It is a field of knowledge that consists of facts which scientists have obtained by systematically observing what people eat and noting how healthy they are. These facts have also been obtained and validated by experimentation to see the effects of various foods and diets on human health.

CONCEPTS

TERMINOLOGY OF NUTRITION

Nurses are important members of health team and committed to maintaining the good health status of the people. They are providing continuity of care in community settings also. Some important terms to understand the concept of nutrition are as follows:

- **Food:** Food refers to the materials of solid or liquid nature which, when ingested, serve one or more functions of growth, maintenance and energy provision. Consuming foods appropriate in both content and kind promotes nutrition and health.
- **Health:** According to World Health Organization (WHO), health is defined as the “state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”.
- **Nutrition:** The science of food, the nutrients and the substances, their action, interaction and balance in relation to health and disease, the process by which the organism (i.e., body) ingests, digests, absorbs, transports, utilizes and excretes food substances.

Or

The process of taking food and using it for growth, metabolism, and repair. Nutritional stages are ingestion, digestion, absorption, transport, assimilation and excretion.

- **Nutrients:** Nutrients are the components in food that are essential for the body in suitable amounts. These include proteins, fat, carbohydrates, vitamins, minerals and water.
- **Nutritionist:** A person who advises about nutrition or works in the field of foods and nutrition.
- **Nutrition labels:** A label format that must be included on foods under certain circumstances, such as when nutrients are added to foods or when a nutritional claim is made for the food.
- **Nutritional status:** The condition of health of the individual as influenced by the intake and utilization of the nutrients is called nutritional status. It can be determined by the medical and dietary history, physical examination and through appropriate biochemical investigations.
- **Nutritional index:** Nutritional indices measure different aspects of growth failure (wasting, stunting and underweight). The main nutritional indices for children are weight-for-height, sex and height, height-for-age, weight-for-age, all compared to values from a reference population. In emergency situations, weight-for-height is commonly used for nutritional assessments.
- **Nutritional requirement:** Nutritional requirement refers to the amount of energy, protein, fat and micronutrients needed for an individual to sustain a healthy life.
- **Nutritional screening:** Nutritional screening refers to the individual-level assessment where each person is measured in order to identify and refer those needing further check-ups or such services as supplementary or therapeutic feeding.
- **Nutrition surveillance:** Nutrition surveillance is defined as the regular collection of nutrition information that is used for making decisions about actions or policies that will affect nutrition.
- **Malnutrition:** Malnutrition is the condition resulting from dietary nutrient deficiency, excess or imbalance of nutrients.

It can either under nutrition or over nutrition:

- Under nutrition refers to the deficiency of calories and/or one or more essential nutrients, or
- Over nutrition refers to an excess of one or more nutrients especially calories.
- **Balanced diet:** A diet containing all essential (macro and micro) nutrients in optimum quantities and in appropriate proportions to meet the requirements.

- **Macronutrients:** Fat, protein and carbohydrates that are needed for a wide range of body functions and processes.
- **Micronutrients:** Essential vitamins and minerals required by the body in small amounts throughout the life cycle.
- **Food fortification:** The addition of micronutrients to a food during or after processing to amounts greater than were present in the original food product. This is also known as 'enrichment'.
- **Food security:** When all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life (1996 World Food Summit definition).
- **Obesity:** A condition characterized by excess body fat, usually defined as body weight 20% above the desirable level.
- **Wasting:** It refers to the result of weight loss associated with an acute period of food shortage or disease and is defined as low weight for height.
- **Chronic energy deficiency (CED):** It is the condition of underweight among adults as a result of prolonged negative energy balance. It is measured through body mass index (BMI). A BMI value of less than 18.5 indicates CED in adults.
- **Body mass index (BMI):** It is the ratio of weight for height, which is often used to estimate body fat. It is obtained by dividing the weight in kilograms by the square of the height in meters. BMI is not an appropriate assessment for growing children, sedentary individuals or women who are pregnant and lactating.
- **Calorie:** Unit used to indicate the energy value of foods. Quantitative requirements are expressed in terms of energy, i.e., kilocalorie (kcal). Newer unit for energy is K joules.
- **Kilocalorie (kcal):** It is the amount of heat required to raise the temperature of 1 L of water by 1 °C; 1 kcal = 1000 cal.
- **Basal metabolic rate (BMR):** It is the rate of metabolism when an individual is at complete rest in a warm environment and is in postabsorptive state (12 hours after taking a meal).
- **Therapeutic diet:** It is the modification of food either in consistency, preparation or nutrients to meet the special nutritional needs of a person suffering from a particular disease or condition.
- **Energy metabolism:** The reactions by which the body obtains and spends the energy from food.
- **Metabolism:** The sum total of all the chemical reactions that go on in living cells; also the transformation by which energy is made available for the use of the organism.
- **Digestion:** Digestion is the mechanical and chemical process of breaking down of food into its smaller molecules, which can then be absorbed into the blood stream.
- **Triglycerides:** The scientific name for the common form of fat, found in both the body and in foods. Most body fat is stored in the form of triglycerides.
- **Vitamins:** Organic, essential nutrients required in small amounts.
- **Minerals:** Inorganic elements; some minerals are essential nutrients required in small amounts.
- **Antioxidants:** Antioxidants are synthetic or naturally occurring substances found in some foods and drinks. They are added to food to prevent oxidation, e.g., vitamin C in fruit juice prevents oxidation. They also may have protective effects on our body by counteracting the negative effects of free radicals (reactive atoms that may lead to cancer and other age-related diseases).
- **Recommended dietary allowance (RDA):** It is the amount of dietary energy and nutrients considered as sufficient for maintaining good health by the people of a country.

HISTORY OF NUTRITION

Humans have evolved as omnivorous hunter—gatherer over the past 250,000 years. The diet of early modern humans varied significantly depending on location and climate. The diet in the tropics tended to depend more heavily on plant foods, while the diet at higher latitudes tended more toward animal products. Agriculture developed about 10,000 years ago in multiple locations throughout the world, providing grains, farming also provided milk and dairy products, sharply increased the availability of meats and diversity of vegetables.

Landmarks in the Fields of Food and Nutrition

- **Around 3000 BC:** Vedic texts mention of scientific research on nutrition. The Bible's Book of Daniel recounts first recorded nutritional experiment.
- **Around 400 BC:** Hippocrates said, "Let food be your medicine and medicine be your food".
- **16th century:** Leonardo da Vinci compared metabolism to a burning candle.
- **1747:** Dr James Lind performed scientific nutrition experiment, discovering that lime juice saved sailors who had been at sea for years from scurvy, bleeding disorders.
- **1770:** Antoine Lavoisier, the "Father of Nutrition and Chemistry", discovered the details of metabolism, demonstrating that the oxidation of food is the source of body heat.
- **1790:** George Fordyce recognized calcium as necessary for food survival.
- **19th century:** The elements carbon, nitrogen, hydrogen and oxygen were recognized as primary components of food.
- **1840:** Justus Liebig discovered the chemical makeup of carbohydrates (sugars), fats (fatty acids) and proteins (amino acids).
- **1860s:** Claude Bernard discovered that body fat can be synthesized from carbohydrate and protein, showing that energy in body glucose can be stored as fat or a glycogen.
- **1880s:** Takaki observed that Japanese sailor developed beriberi but British sailors and Japanese naval officers did not. Adding various types of vegetable meals to the diet of Japanese sailor prevented the disease.
- **1896:** Baumann observed iodine in thyroid gland.
- **1912:** Casimir Funk coined the term vitamin because he thought that these unknown substances were preventing beriberi and pellagra. The word vitamin has been derived from Latin word, 'vita', means 'life' and 'amine' means containing amino acids.
- **1913:** Elmer McCollum discovered the first vitamins fat-soluble vitamin A and water-soluble vitamin C.
- **1919:** Sir Edward Mellanby incorrectly identified rickets as vitamin A deficiency, because he could cure it in dogs with *Cod liver oil*.
- **1922:** McCollum destroyed the vitamin A in *Cod liver oil* but found it still cured rickets, thus identifying vitamin D.
- **1927:** Adolf synthesized vitamin D, for which he won the Nobel Prize in Chemistry.
- **1928:** Albert isolated ascorbic acid.
- **1930s:** William identified essential amino acids, necessary protein components which the body cannot synthesize.
- **1941:** The National Research Council established the first recommended dietary allowances.
- **1992:** The US Department of Agriculture introduced the food guide pyramid.

Effect of Modernization on Nutrition

In recent times, dietary habits of an individual have undergone drastic changes. Due to our changing nutritional pattern, most chronic diseases are spreading worldwide. Lifestyle changes have influenced our lives so much so that we rarely have time to think whether we are eating healthy or not. Due to globalization, people are moving toward junk foods.

Although people are aware of the health hazards caused by such diet, unfortunately measures taken are not as effective as they need to be. There are so many disease conditions prevailing due to modernization in our dietary pattern such as cardiac problems, obesity, food poisoning, diabetes mellitus, hypertension, etc. Traditionally the main aim of nutrition was to prevent and treat nutritional deficiencies and to provide energy to the body for various functions.

Modern diet mainly “Junk food” simply means an empty calorie food.

An empty calorie food means food which is high in calorie but lacks macro and micro nutrients such as carbohydrates, proteins, vitamins, minerals, amino acids and fiber. These food items do not contain nutrients that our body needs to stay healthy. What makes these foods to be called junk is that it contains high level of refined sugar, white flour, trans fat and poly-unsaturated fat, salt and numerous food additives.

Consumption of such kind of food is due to increasing urbanization and industrialization in various countries. Addition to that, person's levels of physical activity, their body composition and physique, life expectancy and patterns of disease also have impact on nutritional status of the individual in modern world.

Balanced diet, personal hygiene and regular exercise are very important to maintain good health. Drug and alcohol abuse in modern urbanization has also put bad impact on the health of people.

It is not impossible to win battle with junk foods against healthy foods. However, one gets addicted to the food readily.

The main key problems due to modernization on health are:

- Under nutrition causes nutrition deficiency and over nutrition leads to obesity, hypertension, hyperlipidemia, diabetes and cancer.
- Lack of proper nutrition also impacts the nutrition of an individual's immunity. Low immunity is observed in infants, children and elderly and in individuals with diseases and serious nutrition defects.

CONCEPTS OF NUTRITION

According to Oxford Dictionary, term “concept” means abstract idea, general belief/view. To know the concepts behind nutrition, we need to understand some definitions and guidelines.

General Nutrition Concepts/Definitions

This may seem so basic, but these words and principles are the foundation to understanding and practicing good nutrition.

- **Calories:** One calorie is the amount of heat that increases the temperature of one kilogram of water by 1°C. In other words, calories represent the amount of energy that a particular food provides to our bodies once it is digested. Excess calories are stored as fats. Over the time, storage of these extra calories will lead to obesity if not burned properly through physical activity.
- **Calorie density:** It is the amount of energy that a food provides per volume measure. Calorically certain foods are calorically dense foods.

- **Nutrient density:** It is a ratio of nutrient content to the total energy content of food. Means how many nutrients a food is providing to individual as compared to amount of calories provided higher the nutrient density of food, more the food is better, e.g., spinach.
- **Variety:** A different food provides different nutrients. So for optimal nutrition, an individual must rely on variety of foods.
- **Balance:** One must eat foods from the entire food group daily for balanced diet. Balance the proteins, fats and carbohydrates in each meal.
- **Moderation:** Eat food in portions instead of eating one item in excess, eat each food in moderation or in other words in portions.
- **Intake versus daily requirements:** Compare your actual intake of food with your daily recommended diet. According to age, sex, weight, height and physical activity, make changes in your diet accordingly for healthy life.
- **Human nutrition:** Refers to provision of essential nutrients necessary to support human life and health.
- **Malnutrition:** It is a condition resulting from the deficiency, excess or imbalance of nutrients. It can be either under nutrition which refers to deficiency of calories of essential nutrients or over nutrition which refers to an excess of one or more nutrients, especially calories.

Basic Concepts of Nutrition

- We eat food to live, to grow, to keep healthy and well and to get energy for work and play.
- Different nutrients when mixed together provide maximum benefits to an individual.
- Every nutrient has its specific role in body to perform.
- A single food itself cannot provide all nutrients required for full growth and health of individual. We need multiple food sources to complete our nutritional needs.
- Various kinds and combinations of food can lead to a well-balanced diet with proper nutrition.
- Requirement of nutrients depends upon age, sex, size, activity and state of health of an individual.
- Handling of food influences the amount of nutrient in food. Its safety, appearance and taste, etc. depend on its handling.
- Trained scientists or expert persons provide suggestions about nutrition.

IMPORTANCE OF FOOD IN HEALTH AND DISEASE

Role of Food

- Promotes health and prevents diseases
- Treats and controls disease condition

Food in the Prevention of Disease

If a person takes balanced diet, i.e., the right kind of foods is consumed in the required amounts, he or she will maintain good health, provided no other factors intervene. Contrary to this, poor eating habits or eating too much or too little will result in poor health. Poor eating habits and malnutrition are like two sides of the same coin.

- Reduced intake of food for specific nutrients leads to nutritional deficiency disorder such as protein-energy malnutrition (PEM), vitamin A deficiency or anemia.
- Nutritional deficiency disorders such as PEM, vitamin A deficiency and anemia may lead to degenerative diseases. Fibers have a valuable role to play in the prevention of disease.

Food as Therapy

Food as a whole and nutrients in medicinal form (oils, syrups, capsules and tablets) are used to treat disease. Diet is an important part of treatment for patients with metabolic disorders such as diabetes. Special dietary modifications are often necessary to maintain the lives of patients who have chronic kidney disease, heart, liver and gastrointestinal disorders. Similarly, dietary modifications are also essential in other situations such as burns, bone fracture and in surgical conditions. Deficiency of a single nutrient is rare. If it does exist, it can be corrected by adding the specific nutrient through the diet or supplementation.

Diseases have Different Origins

- Diseases are caused by nutrient deficiency. For example, protein-energy malnutrition, vitamin A deficiency, iron-deficiency anemia and other nutrient deficiency diseases.
- Diseases are caused due to several factors out of which some are of food and nutrient related. For example, diabetes, coronary heart diseases, renal diseases, etc. Excessive consumption of sugar and refined carbohydrates precipitate diabetes in individuals who are genetically predisposed.

Some diseases are not directly related to food and nutrients, for example, chicken pox, measles, malaria, infectious diseases, etc. Similarly, high intake of fats, especially saturated fats and cholesterol is believed to be a cause of deposition of fats in arteries which leads to narrowing of the vessels also known as atherosclerosis, a leading cause of cardiovascular diseases. In such diseases, diet cannot cure the disease but can prevent the progression and associated complications. Thus, diet therapy helps patient lead a quality life, without which the disease can become uncontrolled. Mild conditions can be controlled by diet alone.

Some of these may be transmitted through food but food is not the root cause. In these conditions, diet therapy is either directly or indirectly prescribed. For example, in febrile conditions, high-energy and high-protein diet is advised due to increased basal metabolic rate.

ROLE OF NUTRITION IN MAINTAINING HEALTH

Health is a state of complete physical, mental and social well-being and not merely the absence of disease and infirmity, according to WHO.

Previously, the concept of health revolved around healing the sick and helping them to maintain their health by educating them regarding foods that can build strength in their bodies. Without good nutritional status of their citizens, no country can develop economically, socially and politically stable. Nutrition affects human health from birth to death, which may be understood by following points:

- Foods rich in nutrient values provide strong immunity to individuals to fight against various dreadful diseases, like tuberculosis. Similarly, on other hand, poor nutritive food may lead to malnutrition. Also postoperative patient's good nutrition helps in wound healing and quick child's recovery.
- Good nutrition is important for optimal growth and development of child. Child's physical growth, mental growth, his learning ability, behavior—all are affected by good nutrition. During pregnancy period, mother requires good amount of nutritional food for the prevention of growth retardation and other abnormalities of the fetus. An old person requires special nutrition to minimize age related disability and functional impairment.
- There are so many diseases which are directly or indirectly related to food and nutrition of an individual, such as diabetes mellitus, coronary heart diseases, renal diseases, etc. Excessive sugar intake and high intake of saturated fats and cholesterol precipitate diabetes and coronary heart diseases in individuals who are predisposed. In such diseases, diet cannot cure the disease but can prevent the progression and the associated complications.

- There are various deficiency diseases which are caused by poor nutrition called nutritional deficiency diseases, like protein-energy malnutrition, goiter, anemia, blindness, etc. To prevent all these diseases, good nutrition is essential.

If we structure our lifestyle with proper nutrition, healthy habits and exercise program, it will affect our health positively and will reduce medical care expenditures.

FACTORS AFFECTING FOOD AND NUTRITION

The term, “food” is conventionally used while referring to the materials of solid or liquid nature which when ingested; serve one or more functions of growth, maintenance and energy provision. Consuming food must be appropriate in both content and kind that promotes nutrition and health. The social scientists, anthropologists and cultural geographers, etc. have been concerned with man’s culture, social activities and food habits. As we all know food habits develop from childhood period and continue thereafter throughout the life. A number of factors influence people’s food habits in their journey of life. These factors are as follows:

Socioeconomic Factors

Fundamental need of life is nourishment through food. It depends upon family resources for adequate and nutritive food. Income of family decides the variety and amount of food to be purchased. Families having high income resources choose a high quality and a variety of foods in their diet, on the other hand, poor family having low income and large families, rely on cheaper variety of foods; which affects their nourishment and lead to malnutrition in many cases.

Cultural Factors

Every culture has its own customs and beliefs regarding nutritional practices. Culture is transmitted from one generation to another. For some cultures food is a basic need to satisfy hunger but for some, cultures, it is a time for family and social sharing. Various religions of the world have some influence on the food habits. For example, Muslims are forbidden from eating pork and Hindus from eating beef. Vegetarians are given a place of honor in Hindu society. All these cultural beliefs affect the health of individuals directly or indirectly.

Traditional Factors

Even in 21st century, traditional beliefs in food habits are still prevalent with larger population of our country who are illiterate or ignorant regarding the nutritive value of food. A social or religious custom prohibiting or restricting a particular practice is known as *Taboos*. Similarly, there are some food *Taboos* in our tradition or Indian culture which affect the health of vulnerable groups, like pregnant women and small children. On comparative basis, many food *Taboos* seem to make no sense at all, as to what may be declared unfit by one group may be declared fit by the other group. For example:

- In India, consumption of papaya fruit by pregnant is believed to lead to abortion.
- Consumption of garlic by lactating mother will increase milk production.
- Classification of food into hot and cold food. Hot food produces more heat in body and leads to development of boils, whereas cold food leads to the development of cold, sore throat, etc.
- Eating clay or starch by pregnant womens is known as pica. There is a belief that baby will not be normal if one does not eat clay or starch.

System of Distribution

Adequate availability of food at natural level does not necessarily lead to adequate availability in all the regions, especially in the deficit and inaccessible regions of country. Market imperfections (like transport problem, inadequate storage capacity, availability of credit and insurance) and governmental restrictions hamper free movement of food grains across intra-national borders. Due to these reasons, cost of food grains rises and availability of nutritional food decreases.

Consumers in the deficient regions have to pay higher prices for food grains than those in the surplus regions, if there will not be proper distribution of food grains. For the poor consumers in the deficient regions, higher prices of food grains may imply lower consumption of food and consequent poor intake of nutrition.

Lifestyle and Food Habit Factors

Evidence suggests that the habit of regularly eating healthy and well-balanced meals contributes to sustained weight maintenance, a better mood, increased energy level, positive inspiration to others and the potential for a quality of life. Scientific studies have shown that proper timing of food and choosing healthy foods can reduce the risk of heart disease, cancer and other diseases. A healthy diet is a lifestyle, not a fad that is dangerous or difficult to maintain. Abundant evidence suggests that the most healthy diets set aside animal products and also reduce fats in general, while including large amounts of vegetables and fruits.

There is an impact of several lifestyle factors on health of an individual, for example, impact of age, weight, smoking, diet, exercise, psychological stress, alcohol consumption and exposure to environmental pollutants.

- **Age:** Young children requires more protein for their growth and development and adolescents require more calories than adults.
- **Weight:** Obesity is associated with a range of adverse health consequences, widely recognized are the increased risk of cardiovascular disease, diabetes and some cancers.
- **Exercise:** There are strong scientific evidence that being physically active can help individual to lead a healthier and happier life. People who do regular activity/exercise have lower risks of many chronic diseases, such as heart disease, type-II diabetes, stroke and some cancers. It also boosts self-esteem, mood, sleep quality and energy, as well as reduces risk of stress and depression.
- **Psychological stress:** Stress is a feeling of strain and pressure. Small amounts of stress may be desired, beneficial and even healthy. Excessive amounts of stress, however, may lead to bodily harm. Stress can increase the risks of strokes, heart attacks, ulcers and mental disorders such as depression.
- **Alcohol consumption:** Long-term use of alcohol is capable of damaging nearly every organ and system in the body.

The food we eat gives our body the information and materials they need to function properly. If we do not get the right information, our metabolic processes suffer and our health declines. In short, what we eat is precursor to our health.

- **Production and transport:** Locally grown foods are consumed more and the availability of the locally grown produce is cheaper. It is readily available and hence forms the staple diet.
- **Superstition:** Many people try to avoid many foods due to their superstitions, e.g., papaya is avoided during pregnancy, as it is believed to cause abortions. Similarly, pregnant women drink milk with saffron to have a fair baby.
- **Geographical area:** People in the coastal areas of Karnataka, Kerala, Goa and West Bengal consume lots of sea food. Rice is the staple food in Andhra Pradesh and Tamil Nadu, as rice grows well in tropical areas. Wheat is the staple food in northern and eastern regions, as wheat is the main crop in temperate regions.

- **Specific dynamic action of food (SDA):** It has been found that there is 8% increase in the production of energy in the form of heat after taking food. This is not due to digestion or absorption but due to stimulating effect of food on the basal metabolism. This stimulating effect is known as specific dynamic action of food. It varies according to different nutrients, e.g., SDA of carbohydrate is 5–6%, protein is 3%, fat is 4% and mixed diet is 12%.
- **Physiological state:** There is increased demand of food in certain physiological conditions, like in pregnant women, lactating mother, etc., due to increased BMR. The need of extra energy is associated with deposition of tissues during pregnancy and secretion of milk during lactation.

MALNUTRITION

Details have been discussed in chapter 8. Please refer to the chapter.

ROLE OF FOOD AND ITS MEDICINAL VALUE

The nutrients in food enable the cells in our bodies to perform their necessary functions. Nutrients are the nourishing substances in food that are essential for growth and development of body. Nutrients give our bodies instructions about how to function. An individual needs to get a basic balance of nutrients every day for proper functioning of body.

If a person takes balanced diet, i.e., the right kind of food in the required amounts, it will maintain good health and on the other hand, poor eating habits or eating too much or too little will result in poor health.

Reduced intake of food leads to nutritional deficiency disorder such as PEM, vitamin A deficiency or anemia, which may lead to degenerative diseases.

Medicinal Value of Fruits in Diet

Fruits are nature's wonderful gift to mankind. They are life-enhancing medicines packed with vitamins, minerals, antioxidants and many phytonutrients. Fruits are composed of many antioxidants. These antioxidants protect us from many diseases, stress and cancers and help our body to develop capacity against these ailments by boosting our immunity level.

- Fruits provide plenty of soluble dietary fibers, which help in lowering cholesterol and fat in body and help in smooth bowel movements to prevent constipation.
- Fruits richer in vitamins, minerals, micronutrients, antioxidants, help the body to prevent or at least prolong the natural changes of aging by protection from damage and rejuvenating cells, tissues and organs.

Medicinal Value of Dry Fruits

Dry fruits are rich source of nutrients such as vitamins and minerals. Consumption of some dry fruits daily enhances the overall bioavailability of nutrients. Raisins, apricots, dates, figs are indeed very good in iron, calcium, zinc, selenium and manganese. In addition, mixing dry fruits with some fresh fruits would help in getting vitamin C which in turn facilitates complete absorption of iron inside the stomach.

Medicinal Value of Vegetable

Like fruits, vegetables are also low in calories and fats but contain good amounts of vitamins and minerals. All green, yellow, orange vegetables are rich source of calcium, magnesium, potassium, iron, beta carotene, vitamin B complex, vitamin C, vitamin A and vitamin K.

- Vegetables too have antioxidant property which help stay away from stress, diseases and cancers and develop capacity to fight against diseases.
- Vegetables are packed with dietary fibers such as cellulose, mucilage, hemicelluloses gums, pectin etc., which retain good amount of moisture in fecal matter and help its smooth passage out of body and prevent chronic constipation, hemorrhoids, colon cancer, irritable bowel syndrome and rectal fissures.

Cereals and its Medicinal Values

Cereals have stored the elements for the germination and growth such as starch, fat, protein, organic mineral salts and vitamins. Cereals constituted the most important article of human food. Cereals are the cheapest and widely available sources of energy. Cellulose, hemicelluloses present in cereal help to improve peristalsis in the intestine and bulk to the stools.

- Cereals contain proteins like albumins, globulins, glutamines, etc. Cereals when consumed with pulses, improve the quality of protein. This protein is required to sustain growth and repair of body tissue.
- Cereals promote age reversal by virtue of their supply of vitamins B and E. These are helpful in providing good protection against heart disease.
- These are also potent sources of minerals especially calcium, phosphorous, magnesium, iron and zinc. High phosphorous is an important component of brain tissues. Generally, fruits and vegetables are poor sources of phosphorous and cereals supplement this deficiency.
- Brown rice supplies potassium which is needed for maintaining water balance and keeping blood pressure down.
- Oats contain rich soluble fibers and is digested slowly and releases slowly the glucose in the intestines for absorption. So it is prescribed in diabetic diets to prevent and control diabetes mellitus.
- Ragi preparation foods are good to eat in case of iron deficiency anemia.

Medicinal Value of Spices and Condiments

Daily use of spices and condiments in Indian diet is very common for their rich flavor and their healing power. Their benefits are many, be it for spiritual reasons or to spice up our taste buds, or as a home remedy for ailments like cold, or sore throat, etc.

- Essential oils in them have been found to have anti-inflammatory function, preparing them for symptomatic relief in inflammatory health problems such as rheumatoid arthritis, osteoarthritis and ulcerative colitis.
- Many unique compounds in them can reduce blood sugar levels in diabetes.
- Garlic has certain compounds which help in reduction of cholesterol and blood pressure and help in cutting down coronary artery disease and stroke risk.
- Daily use of onion prevents heart attack.
- Ginger reduces pain and swelling in people with arthritis. It also works against migraines by blocking inflammatory substances called prostaglandin. It also plays a role in preventing and slowing down the growth of cancer.

- Turmeric is also a potentially powerful cancer fighter. Research suggests that it may protect against colon cancer as well as melanoma, the deadliest form of skin cancer.
- Cinnamon has become most famous for its ability to improve blood sugar control in people with diabetes. Cinnamon can even help prevent blood clot, making it especially heart smart.

Medicinal Value of Curd or Yogurt

Curd is taken in various forms throughout the world, as it has several benefits. No meal in India is complete without curd or buttermilk. It contains probiotic or friendly bacteria that thrive in our intestine and protect us against intestinal infections. It also increases digestibility.

Medicinal Value of Green Tea

Green tea protects us from digestive and respiratory tract infections. It is also believed to have anticarcinogenic properties and prevents against colon and stomach cancers.

NUTRIENTS

CLASSIFICATION OF NUTRIENTS

A nutrient is anything that nourishes a living being. We humans get our nutrients from what we eat, plants get it from the soil. It is important for our health to get the proper nutrients. Food pyramid shows the food items in a balanced amount for healthy diet (Fig. 1.1). Different foods contain different nutrients. They give us energy to perform daily functions, as well as fuel to build tissues and grow. These nutrients are broken up into two distinct categories.

- Macronutrients
- Micronutrients

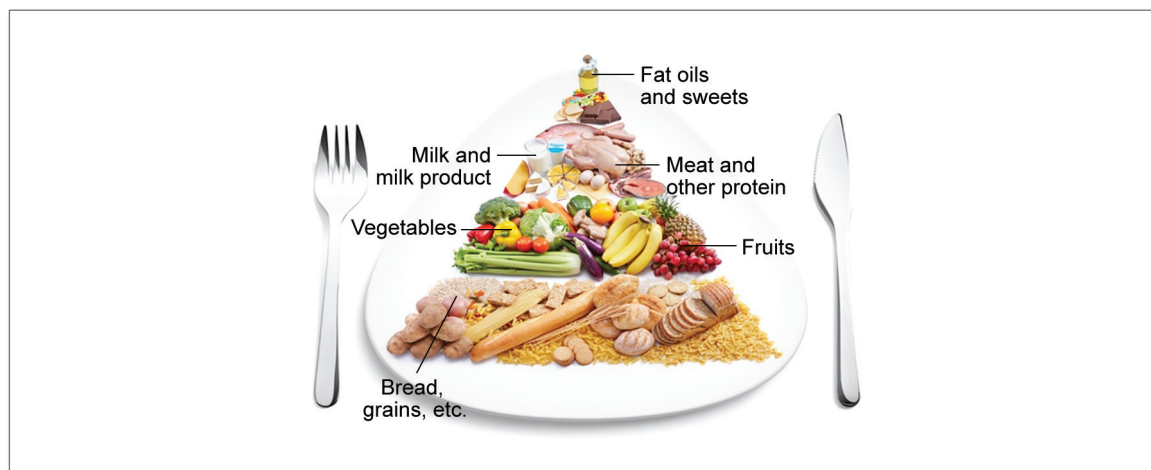


Fig. 1.1 Food pyramid

MACRONUTRIENTS AND MICRONUTRIENTS

Macronutrients

Macronutrients are substances that provide calories which are metabolized for energy. They are called macronutrients because human needs them in large amount. Macronutrients are vital for every function we perform in the body because they serve as fuel for the body. Main three macronutrients with their own caloric value are as follows:

- Carbohydrates = 4 kcal/g
- Fats = 9 kcal/g
- Proteins = 4 kcal/g

Carbohydrates

Carbohydrates are the major source of energy. About 50–70% of energy value in the average diet is provided by carbohydrates. They are easily converted into fuel. Digestive system changes carbohydrates into glucose. Body uses this glucose for energy for cells, tissues and organs.

Caloric Value of Carbohydrates

Humans need a minimum intake of food energy to sustain their metabolism and to drive their muscles. In our country, 60–80% of a day's energy needs are met from carbohydrates in the form of starch derived from cereals and pulses. Calories are needed to provide energy for the functioning of the body. The number of calories in a food depends on the amount of energy the food provides. The number of calories a person needs depends upon his age, height, weight, gender and activity level. Foods are composed of mainly carbohydrates, fats, proteins, water, vitamins and minerals. Carbohydrates, fats, proteins and water represent all weight of food but vitamins and minerals make up only small percent of weight.

These elements are produced different quantities of energy when burnt. The amount of energy produced when one gram of any of these elements is burnt is known as its calorific value.

The caloric value of carbohydrate is 4 calories.

Recommended Daily Allowances (RDA)

It is the amount of nutrient and calorie intake per day considered necessary for maintenance of good health, calculated for males and females of various ages and recommended by the food and nutrition board of National Research Council.

Children and adults should consume 45–65% of their calorie intake as carbohydrates and at least 130 g of carbohydrates per day. To find out number of grams of carbohydrates needed each day calculate 45–65% of your total calorie intake and dividing by 4. For example, if we eat 2,000 calorie diet then the amount of carbohydrate is 225–325 g/day.

Dietary Sources

The important sources of carbohydrates in the children and adults are cereals, millets, roots, tubers, pulses, sugar and jaggery. Milk and sugar are important sources in the diets of infants.

Proteins

They are one of the building blocks of body tissues and can also serve as a fuel source. Proteins are required for growth in children and maintenance of body weight in adults. Protein constitutes about 20% of the body weight. Protein can be found in all cells of body by mainly in muscles. Food rich in protein includes meat, poultry, fish, nuts, egg, milk and milk products. Proteins are made up of simpler chemical substances known as amino acids. The nutrient value of protein depends on their amino acid contents.

Caloric Value of Proteins

Calories are needed to provide energy to body for proper functioning. The number of calories in a food depends on the amount of the energy the food provides. One gram of protein gives 4 kcal. The recommended daily allowances for protein are given in Table 1.1.

Dietary Sources

Animal products are rich sources of proteins. Animal protein has a balanced combination of all the amino acid, hence it is called as complete protein. On the other hand, plant protein is incomplete except soybean protein. So a vegetarian person requires a variety in plant protein sources for proper development. Incomplete protein is deficient in one or more of the essential amino acids.

Animal sources

Meat, egg, milk, cheese, fish, egg proteins are considered to be the best among food proteins because of their high biological value and digestibility.

Vegetable sources

It includes pulses, beans, cereals, nuts and oilseeds. In developing countries like India, cereals and pulses are the main sources of dietary protein because they are cheap, easily available and consumed in bulk.

TABLE 1.1: Recommended dietary allowances for protein

Group	Particulars	Protein (day)
Man	Sedentary work Moderate work Heavy work	60
Woman	Sedentary work Moderate work Heavy work Pregnant woman Lactating woman	50 50 + 15
	0–6 months 6–12 months	50 + 25 50 + 18
Infants	0–6 months 6–12 months	2.05 kg 1.65 kg
Children	1–3 years 4–6 years 7–9 years	22 30 41
Boys	10–12 years	54
Girls	10–12 years	57
Boys	13–15 years	70
Girls	13–15 years	65
Boys	16–18 years	78
Girls	16–18 years	63

Fats

Fat is a major nutritional element and a vital aspect of healthy diet. Fat helps to maintain body temperature. Fat cushions organs which protects them from trauma. Excessive fats lead to obesity. A molecule of dietary fat typically consists of several fatty acids. Fats may be classified as saturated or unsaturated depending on the structure of fatty acid involved.

Micronutrients

These are essential dietary elements that are needed only in very small quantities. Micronutrients are also known as trace elements. This group includes vitamins and minerals (Fig. 1.2).

Vitamins

Vitamins are micronutrients as they are required in small amount. Vitamins are organic compounds occurring in small quantities in different natural foods and necessary for the growth and maintenance of good health in human beings. Many of them cannot be synthesized, at least inadequate amounts, by the body and must be obtained from the diet. So far, about 15 different vitamins have been isolated in a pure state from natural foods. Vitamins may be classified broadly into two groups as given in Table 1.2.

- Fat-soluble vitamins
- Water-soluble vitamins

Minerals

Mineral elements are chemical substances found in body tissues and fluids. They occur in foods as salts. The body contains about 24 minerals, all of which must be provided by the diet. Broadly the two kinds of minerals are: macrominerals and trace minerals.

The microminerals consist of calcium, phosphorus, manganese, sodium, potassium, chloride and sulfur.

The trace means in little quantity but even body needs them equally. Trace minerals include iron, manganese, copper, iodine, zinc, cobalt, fluoride and selenium. All have different functions in our body like calcium is required for bones and teeth. Phosphorus is the constituent of body cells of soft tissues such as muscles, liver, etc. Iron and copper help in formation of hemoglobin. Zinc is a constituent of an enzyme. The recommended dietary allowance for minerals is given in Table 1.3.

Functions of Minerals

The functions of minerals are following:

- Minerals play a main role in the maintenance of osmotic pressure, and thus regulate the exchange of water and solutes within the animal body.
- Minerals are essential constituents of skeletal structures such as bones and teeth.
- Minerals serve as structural constituents of soft tissues.



Fig. 1.2 Sources of micronutrients

TABLE 1.2: Classification of vitamins

Fat-soluble vitamins	Water-soluble vitamins
• Vitamins A (Retinol) and carotenes. • Vitamin D ▪ (D₂ - Calciferol) ▪ (D₃ - Cholecalciferol) • Vitamin E (Tocopherol) • Vitamin K (Quinones) (K₁-K₂)	• Vitamin B₁ (Thiamine) • Vitamin B₂ (Riboflavin) • Vitamin B₆ (Pyridoxine) • Vitamin B₁₂ (Cyanocobalamin) ▪ Folic acid ▪ Biotin ▪ Choline ▪ Vitamin B₁₂ • Vitamin C (Ascorbic acid)

TABLE 1.3: Recommended dietary allowance for minerals

Minerals	Recommended daily intake
Calcium	1,000 mg
Chlorine	3,400 mg
Chromium	120 g
Copper	2 mg
Fluorine	3.5 mg
Iodine	150 mcg
Iron	15 mg
Manganese	5 mg
Magnesium	350 mg
Molybdenum	5 mg
Nickel	<1.8 mg
Phosphorus	1,000 mg
Potassium	3,500 mg
Selenium	35 g
Sodium	2,400 mg
Vanadium	<1.8 mg
Zinc	15 mg

- Minerals are essential for the transmission of nerve impulses and muscles contraction.
- Minerals play a vital role in the acid-base equilibrium of the body, and thus regulate the pH of the blood and other body fluids.
- Minerals serve as essential components of many enzymes, vitamins, hormones and respiratory pigments, or as cofactors in metabolism, catalysts and enzyme activators.

Functions and sources of macrominerals have been discussed in Table 1.4.

TABLE 1.4: Functions and sources of macrominerals

Trace Macro-minerals	Functions	Sources
Sodium	Proper fluid balance, nerve transmission and muscle contraction in the body.	Table salt, soy sauce, large amounts in processed foods, small amounts in milk, breads, vegetables and unprocessed meats.
Chloride	Proper fluid balance and stomach acid.	Table salt, soya sauce, milk, meats, breads and vegetables.
Potassium	Proper fluid balance, nerve transmission and muscle contraction in the body.	Meats, milk, fresh fruits, vegetables, whole grains and legumes.
Calcium	Provides healthy bones and teeth and helps muscles to relax and contract, important in nerve functioning, blood clotting, blood pressure regulation and immune system health.	Milk and milk products, canned fish with bones (salmon, sardines), fortified tofu and fortified soy milk, green broccoli, mustard greens and legumes.

Contd...

Trace Macro-minerals	Functions	Sources
Phosphorus	Important for healthy bones and teeth and found in every cell part of the system that maintains acid-base balance.	Meat, fish, poultry, eggs, milk and processed foods.
Magnesium	Magnesium found in bones and needed for making protein, muscle contraction, nerve transmission and immune system health.	Nuts and seeds, legumes, leafy, green vegetables, seafood, chocolate and "hard" drinking water.
Sulfur	Sulfur found in protein molecules.	Foods as part of protein: meats, poultry, fish, eggs, milk, legumes and nuts.

Trace minerals (Microminerals)

Human body needs trace minerals in very small amounts. Iron is considered as a trace mineral. The amount of iron needed is more than any other micromineral. Functions and sources of trace minerals have been discussed in Table 1.5.

TABLE 1.5: Functions and sources of trace minerals

Trace minerals	Functions	Sources
Iron	Iron is an important part of a molecule (hemoglobin) found in red blood cells that carries oxygen in the body and needed for energy metabolism.	The sources of iron are organ meat, red meat, fish, poultry, shellfish (especially clams), egg yolks, legumes, dried fruits, dark leafy greens, iron-enriched breads, cereals and fortified cereals.
Zinc	Part of many enzymes; needed for making protein and genetic material; has a function in taste perception, wound healing, normal fetal development, production of sperm, normal growth and sexual maturation, immune system health.	The sources of zinc are meat, fish, poultry, leavened whole grains and vegetables.
Iodine	Iodine is found in thyroid hormone which helps regulate growth, development and metabolism.	Seafood, foods grown in iodine-rich soil, iodized salt, bread and dairy products.
Selenium	Selenium is antioxidant.	Meat, seafood and grains.
Copper	Copper is a part of many enzymes, needed for iron metabolism.	Legumes, nuts and seeds, whole grains, organ meats and drinking water.
Manganese	Manganese is a part of many enzymes.	Present in foods, especially plant foods.
Fluoride	Fluoride is involved in formation of bones, teeth and helps prevent tooth decay.	Present in drinking water (either fluoridated or naturally containing fluoride), fish and most teas.
Chromium	Chromium works closely with insulin to regulate blood sugar (glucose) levels.	Chromium is found in unrefined foods, especially liver, brewer's yeast, whole grains, nuts, cheeses.
Molybdenum	Molybdenum is a part of some enzymes.	Legumes, breads, grains, leafy green vegetables, milk liver.

Other trace nutrients known as essential that are in tiny amounts include nickel, silicon, vanadium and cobalt.

Water

Water is an absolutely essential part of a healthy diet. Without proper hydration the functions of many nutrients cannot be performed properly. Water is required for carbohydrates to dissolve into glucose, for minerals to function properly and for fat to protect vital organs. The presence of water in the body works with nutrients to provide proper function (Fig. 1.3).



Fig. 1.3 Water is essential part of healthy diet

Functions of Water to Maintain Normal Cellular Functions

- Water is essential constituent of all cells of body.
- Water provides medium for transportation and exchange of nutrients in body.
- For metabolic reactions within the cell, water provides a medium for its reaction.
- Water assists in regulating body temperature of the body.
- Water is a valuable solvent in which various substances such as electrolytes, hormones, enzymes and vitamins are carried from one place to another and act as lubricant.
- Water forms a part in body tissues, e.g., the amniotic fluid surrounds and protects the fetus during pregnancy.
- Water helps in maintaining the form and texture of tissues.
- Water helps for maintenance of acid-base balance in body.

Requirement of Daily Water in Body

For the maintenance of normal fluid balance, it is necessary that body water intake and output should be approximately equal.

In India, the average fluid intake and output is usually about 2500 mL in 24-hour period.

The minimum 6–8 glasses of water is recommended to keep one active. The consumption of water depends upon climate conditions, standard of living, physical activities and habits of people. Water should be consumed at regular intervals.

ORGANIC AND INORGANIC NUTRIENTS

According to different chemical structures, we can classify nutrients into two categories, i.e., organic and inorganic nutrients.

Organic nutrients have carbon in its chemical structure but inorganic nutrients do not contain carbon in its chemical structure. Organic nutrients include carbohydrates, lipids, proteins and vitamins. Their basic structure contain carbon in it. These nutrients are collectively referred to as the energy-yielding nutrients. Whereas inorganic nutrients (minerals) are essential for the growth of living things.

Inorganic nutrients do not contain carbon. There are only two groups of inorganic foods that we need to be concerned about are minerals and water.

ENERGY YIELDING AND NON-ENERGY YIELDING NUTRIENTS

Carbohydrates, fats and proteins are referred to as energy-yielding macronutrients because they supply energy to human body. Carbohydrates contain 4 calories per gram. Like carbohydrates protein contain 4 calories per gram and fat contains 9 calories per gram. Carbohydrates should provide 45–65% of our daily calories. Proteins should provide 35% of our daily calories. Fats should provide 20–35% of our daily calories. Non energy yielding nutrients don't offer fuel in the form of calories, they provide additional essential components that support growth and promote health. A well-balanced diet provides the range of vitamins and minerals we need each day.

FOOD

Food is a substance that is consumed by an individual for nutritional support. Food contains nutrients such as carbohydrates, fats, proteins, vitamins or minerals.

Food may be defined as food is any edible material that we usually consume to fulfill our daily nutritional requirement. Individuals body will utilize the nutrients for growth, repair and maintenance. Body requirement of nutrients fulfilled by the food we consume.

ORIGIN OF FOOD

The food we eat mostly come from the nature. Food is originated from plants, animals, fruits vegetables.

Plant Origin

- The food that is obtained from plants and provides us with minerals.
- Fruits, vegetables, legumes, nuts, cereals, etc.
- Salt and water is also considered to be mineral origin.

Animal Origin

- The food that is obtained or come from animals.
- Meat, fish, milk, seafood, egg, honey, butter, etc.

FOOD GROUPS

Now we come to know that food that we eat come from animals, plants and minerals. Now we discuss that food is further classified into six groups according to their functions in human body.

1. **Fats:** Oil butter and margarine
2. **Milk and dairy food:** Milk, yogurt and cheese
3. **Fruits:** Apple, pear, orange, banana, watermelon, grapes, strawberries, etc.
4. **Proteins:** Meat, egg, vegetables, seafood, fish and nuts
5. **Vegetables:** Spinach, cauliflower, mushrooms, pepper, carrot, tomato, etc.
6. **Starchy food:** Pasta, rice, corn, cereals, sweet potatoes, oat meals, etc.

Classification of Food

Food is any substance consumed to provide nutritional support for the body. It is mainly of plant or animal origin. Foods may be broadly classified into two groups based on their nutritive value.

Classification of food by chemicals:

- Carbohydrates
- Fats
- Proteins
- Vitamins
- Minerals

Classification of food by sources:

- Cereals and millets
- Fats and oils
- Meat, fish, eggs, and milk
- Legumes
- Green vegetables
- Nuts of oilseeds
- Sugar and jaggery
- Condiments of spices
- Others

Classification of foods by origin:

- **Foods of animal origin:** For example, milk, meat, eggs, etc.
- **Foods of vegetables origin:** For example, pulses, cereals and fruits.

Classification based on functions (Fig. 1.4)

The different groups of foods listed above may be broadly classified under three heads from the nutritional point of view or on the basis of functions:

- **Energy-yielding foods:** Foods rich in carbohydrate and fats are energy yielding foods. For example, cereals, roots, tubers, sugars, oils and butter.
- **Body-building foods:** Protein-rich foods are considered as body building foods. The main function of protein is to build and repair tissues. For example, meat, poultry and legumes.

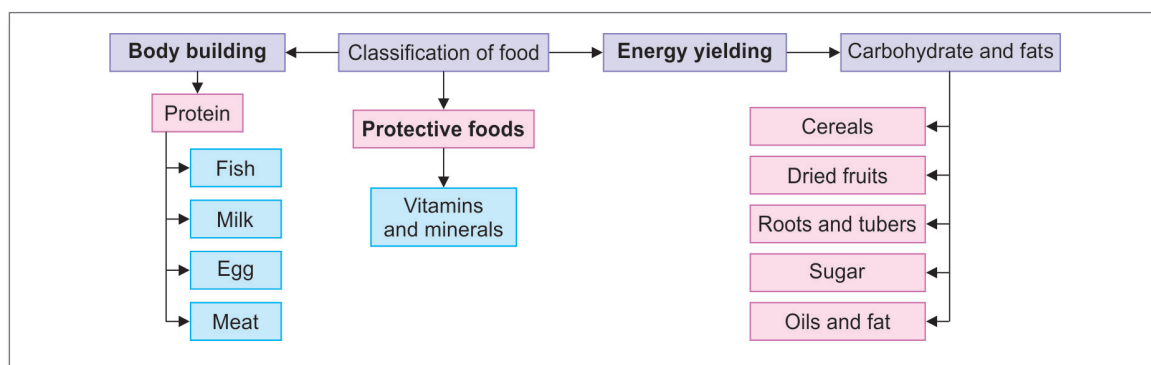


Fig. 1.4 Classification of food based on functions

- **Protective foods:** Foods rich in proteins, vitamins and minerals are considered as protective food. For example, fruits, green leafy vegetables, eggs and milk.

Classification based on the types of nutrients (Fig. 1.5)

It can be further divided into two main categories:

1. Macronutrients
2. Micronutrients

Macronutrients are those nutrients required by the human body in large amounts such as carbohydrates, proteins and fats.

Micronutrients are those nutrients required by body in small amounts, such as vitamins and minerals.

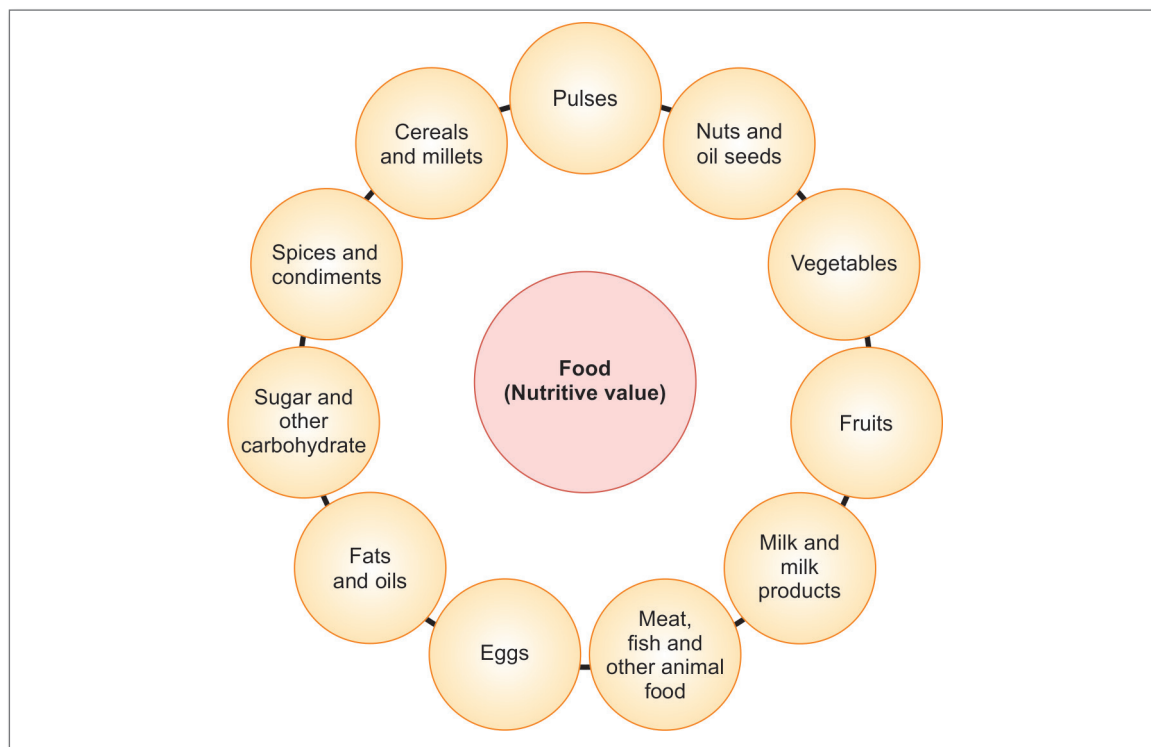


Fig. 1.5 Classification of food based on the types of nutrients



Assess Yourself

LONG ANSWER QUESTIONS

1. What do you mean by nutrition and health? Explain.
2. What do you mean by malnutrition? Give answer in detail.
3. What do you mean by organic and inorganic nutrients? Give answer in detail.

Contd...

SHORT ANSWER QUESTIONS

1. What are the five main food groups?
2. What are the energy yielding nutrients?
3. Give classification of food according to its origin.
4. How lifestyle and habits affects nutritional status of an individual?

MULTIPLE CHOICE QUESTIONS

1. Nutrition that is given directly through means is:
 - a. Intravenous
 - b. Saline
 - c. Parenteral
 - d. Enteral
2. _____ is the mode of obtaining food for growth, repair, energy and maintenance:
 - a. Nutrition
 - b. Fatty acid
 - c. Carbohydrates
 - d. Calorie
3. Macronutrients are:
 - a. Minerals, vitamins and proteins
 - b. Carbohydrates, vitamins, fats
 - c. Proteins, carbohydrates and fats
 - d. Fats, proteins and minerals
4. Which nutrient provides greatest energy program?
 - a. Carbohydrates
 - b. Fat
 - c. Protein
 - d. Water
5. Following are the components of food, except:
 - a. Vitamins
 - b. Fiber
 - c. Carbohydrates
 - d. Proteins
6. Nutrients that are known as body builders:
 - a. Proteins
 - b. Vitamins
 - c. Minerals
 - d. Carbohydrates
7. Nutrients that are used to produce energy are:
 - a. Fats and proteins
 - b. Proteins and carbohydrates
 - c. Vitamins and proteins
 - d. Fats and carbohydrates
8. One gram of glucose produces _____ energy:
 - a. 4.8 kilocalories
 - b. 3.8 kilocalories
 - c. 5.2 kilocalories
 - d. 4.2 kilocalories
9. Nutrients found in food are all, except:
 - a. Carbohydrates
 - b. Vitamins
 - c. Plasma
 - d. Protein
10. Vitamins and minerals are needed by the body because:
 - a. They insulate the body's organ
 - b. They give energy to the body
 - c. They help to carry out metabolic reaction
 - d. They withdraw heat from the body
11. Following are considered as nutrients, except:
 - a. Fats
 - b. Fiber
 - c. Minerals
 - d. Vitamins

Answers to MCQs

1. c 2. a 3. c 4. b 5. b 6. a 7. d 8. d 9. c 10. c 11. b