NETAJI SUBHAS OPEN UNIVERSITY

Under Graduate Degree Programme
Choice Based Credit System (CBCS)

SELF LEARNING MATERIAL

ZOOLOGY
[HZO]

Food, Nutrition and Health

GE – ZO – 41

PREFACE

In a bid to standardize higher education in the country, the University Grants Commission (UGC) has introduced Choice Based Credit System (CBCS) based on five types of courses *viz. core, discipline specefic, generic elective, ability and skill enhancement* for graduate students of all programmes at Honours level. This brings in the semester pattern, which finds efficacy in sync with credit system, credit transfer, comprehensive continuous assessments and a graded pattern of evaluation. The objective is to offer learners ample flexibility to choose from a wide gamut of courses, as also to provide them lateral mobility between various educational institutions in the country where they can carry their acquired credits. I am happy to note that the university has been recently accredited by National Assessment and Accreditation Council of India (NAAC) with grade ''A''.

UGC (Open and Distance Learning Programmes and Online Programmes) Regulations, 2020 have mandated compliance with CBCS for UG programmes for all the HEIs in this mode. Welcoming this paradigm shift in higher education, Netaji Subhas Open University (NSOU) has resolved to adopt CBCS from the academic session 2021-22 at the Under Graduate Degree Programme level. The present syllabus, framed in the spirit of syllabi recommended by UGC, lays due stress on all aspects envisaged in the curricular framework of the apex body on higher education. It will be imparted to learners over the six semesters of the Programme.

Self Learning Materials (SLMs) are the mainstay of Student Support Services (SSS) of an Open University. From a logistic point of view, NSOU has embarked upon CBCS presently with SLMs in English / Bengali. Eventually, the English version SLMs will be translated into Bengali too, for the benefit of learners. As always, all of our teaching faculties contributed in this process. In addition to this we have also requisitioned the services of best academics in each domain in preparation of the new SLMs. I am sure they will be of commendable academic support. We look forward to proactive feedback from all stakeholders who will participate in the teaching-learning based on these study materials. It has been a very challenging task well executed, and I congratulate all concerned in the preparation of these SLMs.

I wish the venture a grand success.

Professor (Dr.) Subha Sankar Sarkar
Vice-Chancellor

Netaji Subhas Open University

Under Graduate Degree Programme
Choice Based Credit System (CBCS)
Subject : UG Zoology (HZO)

Course : Food, Nutrition and Health

Course Code : GE-ZO-41

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Netaji Subhas Open University

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Open University

UG : Zoology
Generic Elective
GE-ZO-41

Course : Food, Nutrition & Health

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1.1 Objectives

This unit under the module 'Food, Nutrition and Health' covers various aspects of basic concept of food and nutrition. This particular unit gives an impression about food components and nutrients that serves the needs of various types of peoples of different age groups. After completion of this study material the reader would be able to understand.

- The basic components of the foods and food nutrients.
- What a balance diet is?
- About the dietary pattern for different age groups.
- The amount of food requires to maintain health.

1.2 Introduction

Nutrition, nourishment, refers to the nurturing of our body to keep it healthy and functioning as it is supposed to do. Nature has provided a variety of foods for man to consume and be healthy. We consume food for maintenance of health, growth and to develop greater resistance against infections. Nutrition is an art and also a science. Nutrition thus can be defined as "the science of foods, the nutrients and other substances, they are in action, interaction and balancing in relation to health and disease." On the other hand food is the material consisting essentially of protein, carbohydrate, and fat used in the body of an organism to sustain growth, repair, and vital processes and to furnish energy; also, such material together with substances as minerals, vitamins, and condiments.

Nutrition as a science was found by Lavoisier (the father of modern chemistry and also the father of nutrition) towards the end of 18th century. The science of

nutrition is one of the youngest of the sciences. The essential nutrients, proteins, fats and carbohydrates have been recognized in the early 19th century.

Specific nutritional disorders were identified such as Protein energy malnutrition, Vitamin A deficiency, Endemic goiter, Nutritional Anemia, Nutritional blindness etc. and measures were found to prevent and control these disorders. The science of Nutrition was extended to other fields like agriculture, animal husbandry, economics and sociology. This led to "green revolution" and "white revolution" and increased food production.

1.3 Food components and food-nutrients

We eat different meals a day and a meal could consist of bread omlete and milk in Breakfast, rice, daal (pulses, vegetable, curd, and salad) and chapatti in Lunch potato chips or burger in Snacks and fish curry in Dinner. We eat food not just to stop rumbling sound that comes from our stomach when we are hungry but also to gain energy to do work for whole day. For a healthy heart, working muscles and active brain, we must eat a balanced diet that gives nutrients to our body. These nutrients will get strong bones as well as energy. The study of compositions of food materials and the quantities of food materials required by our body for growth, maintenance and survival is called Nutrition. A nutrient is an organic or an inorganic substance required for the survival of a living being.

1.3.1 Food component

Food has many different components and each component is necessary for one function or the other. The major components of our food are: (Fig.1.1)

1. Carbohydrates
2. Fats
3. Proteins
4. Mineral (salts)
5. Vitamin
6. Water
7. Roughage

Fats

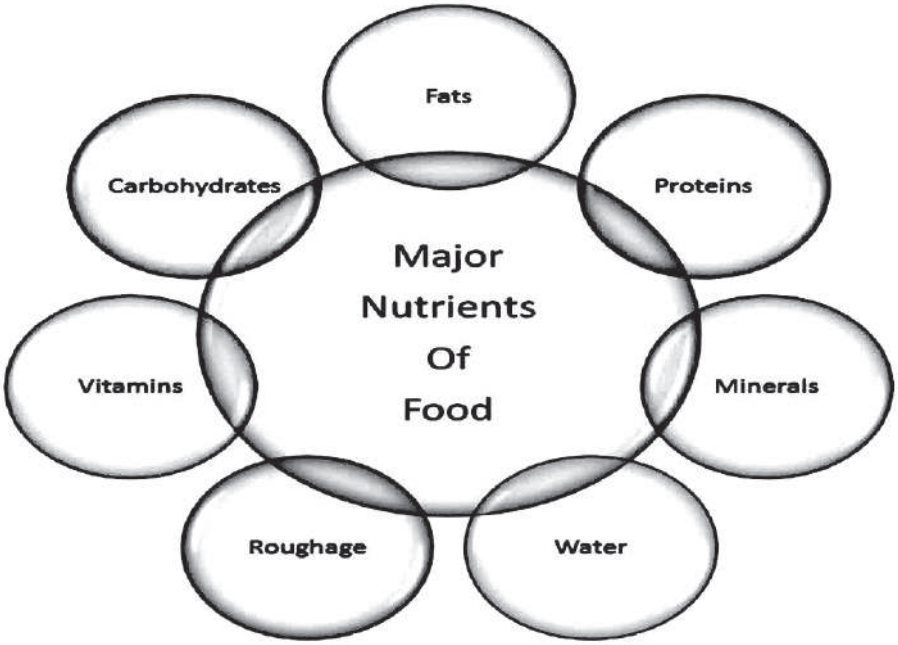

Fig.1.1 *Major component of food*

The carbohydrates, proteins, fats, minerals, salts and vitamins are called nutrients (described below) because they are required for the survival of living beings like human beings. Water is an important constituent of our food and makes up for two third of our body weight, it is usually not considered a nutrient. Roughage keeps digestive system going. Our diet usually contains the entire nutrient in varying a mounts. For example, egg or meat give us proteins, butter and ghee give us fats, whereas fruits and vegetables give use minerals and vitamins.

1.3.1.1 Carbohydrates

Carbohydrates are the compound a made up of three elements: carbon, hydrogen and oxygen, proportion of hydrogen and oxygen being the same as in water (the term carbohydrates actually means hydrates of carbon)

Glucose, sucrose, and starch are example of carbohydrates. Carbohydrates are the main source of energy in our body. Though carbohydrates are not the richest source of energy, they are the cheapest source of energy. The carbohydrates produce energy when they are the oxidized in the body. 1 gram of carbohydrates produce kilojoules of energy and about 60 percent to 80 percent of the total energy contained in our diet (or food*)* comes from carbohydrates present in it. About 400-500 gram of carbohydrate

is requiring daily for a normal person. A growing child, a nursing mother or a sports man, however, need more carbohydrate than cellulose. Cellulose is also a carbohydrate, but is not a food this is because cellulose cannot be digested or absorbed in the body. When eaten, however, cellulose acts as a roughage & help in keeping the intestinal tract in good working order that is, cellulose helps in the maintaining healthy digestive system.

1.3.1.1.1 Sources of carbohydrates

The carbohydrates in our food are obtained mainly from the plants sources like wheat, rice maize, potatoes, potatoes, sago (sabu-dana), peas, beans & fruit. Milk also contains a sugar called lactose. The sugar is obtained from food. The world's three main cereal crops (or starchy food), which provide us carbohydrates, are: wheat, rice and maize. In other words, wheat rice & maize are abundant in starch. Out of these, food from wheat is prepared in the form of roti, bread. Rice is used as such or in various other forms of food products such as oat, bread, noodles, rice, dosa, idli, etc.

1.3.1.2 Fats

Fats are esters of long chain fatty acids and an alcohol called glycerol. The fats are actually made of the same three elernents, carbon, hydrogen, and oxygen, of which the carbohydrates are made. The difference lies in the fact that fats contain less proportion of oxygen as fats consist of three molecules of a fatty acid and one molecule of glycerol. Fats are the members of a heterogeneous group of organic compounds known as lipids. Like carbohydrates, the main function of fats in the body is to provide a steady source of energy, and for this purpose they are deposited in various fat depots within the body and under the skin. In fact, fats provide twice as much energy as that provided by the same amount of a carbohydrate. For example, 1 gram of a carbohydrates on oxidation in the body during respiration gives about 17 Kilojoules or 4 kcal of energy whereas 1 gram of a fat (or oil) gives about 37 Kilojoules or 9 kcal of energy which is more than double than that given by carbohydrates. The fats provide more energy than carbohydrates because fat molecules contain higher percentage of carbon and hydrogen but less percentage of oxygen than that of carbohydrates. Due to less percentage of oxygen present in it, a fat molecule requires more oxygen for it combustion and hence produces less heat energy. From this discussion we conclude that both, carbohydrates and fats, serve mainly as sources of energy to our body. Actually, fats are the richest source of

energy to our body, but they are more expensive than carbohydrates. Fats can also be stored in the body for subsequent use. The fats present in our food cannot be absorbed by our body as such because they are complex organic molecules which are insoluble in water.

1.3.1.2.1 Sources of Fats

Fats are supplied to our body by many foods like butter, milk, egg etc. All the cooking oils provide us fats. The fats which we eat in our food are dietary fats. All the above given food items contains dietary fats.

1.3.1.3 Proteins

Proteins are highly complex organic compound made up of carbon, hydrogen, oxygen and nitrogen. Some of the protein also contains elements such as sulphur and phosphorus. Proteins are very important in our food for growth and repair of the body. Proteins are essential for the growth of the child and teenagers, and proteins are needed for maintenance and making good the wear and tear of body tissues in adults. In addition to all this, proteins also supply some energy to the body. Proteins are made up of nitrogen containing compounds called amino acids. Amino acids link through peptide bonds to form protein molecules. There are more than 20 of these amino acids and they all occur in almost all proteins. But the relative amount of each amino acid present differs in different proteins. Most of the proteins which are required to perform different function in our body are prepared within the body from the unbounded amino acids.

It should be noted that the proteins consumed in our food are not used by our body in their original from. This is because of two reasons. Firstly because proteins are insoluble in water and secondly they are very complex molecules. When the food is digested in small intestine, the proteins present in the food are broken down into simpler substances called amino acids. The amino acids are water soluble and less complex molecules. The amino acids thus formed are absorbed from the intestine into the blood. The blood carries these free amino acids to the various body cells where they are regrouped to form specific proteins such as skin, muscle, blood & bones.

1.3.1.3.1 Sources of proteins

We can get proteins from plant sources as well as animal sources. Some of plant proteins are: ground-nuts, beans, whole cereals like wheat and maize, and pulses.

Some of the best sources of animal proteins are: lean meat (meat without fats), fish, eggs, milk and cheese. These are all body building foods. The most valuable proteins are found in milk and eggs. They contain all the amino acids required by our body. These proteins are particularly need by children.

1.3.1.4 Vitamins

Vitamins are the complex organic compounds found in some foods which are necessary for the well-being of the entire body. Vitamins are necessary for normal growth, good health, good vision, proper digestion, healthy teeth, gums, and bones, and for life to be maintained. Vitamins act as catalysts in certain chemical reaction of metabolism in our body. Vitamins do not provide energy to our body, so in this respect they differ from carbohydrates and fats which provide energy. Though vitamins are needed by our body in minute quantities but their presence is essential in our diet. More than 15 vitamins are known at present and each one of these is needed for a specific purpose is the body.

1.3.1.4.1 Sources of Vitamins

Some of the important vitamins are; vitamin A, Vitamin B complex, vitamin C, vitamin D, Vitamin E and Vitamin K. Most of vitamins cannot be made by body, so they have to supply through various foods which contain them. Only two vitamins called vitamin D and vitamin K can be made in our body. All the vitamins are prepared in plants. Sources of Vitamins are fruits and vegetables from plant source, fish/meat liver, milk from animal source.

1.3.1.5 Minerals

The metals, non metals & their salts are called minerals because they are mined form the soil, ground and the earth. Our body needs minerals for its proper functioning, normal growth and good health. Minerals are needed to build bones, teeth, formation of red blood corpuscles, and coagulation of blood, functioning of muscles, nerve & thyroid gland etc. Several minerals are needed to enzymes to do their work. Some of the important minerals needed by our body are: iron, iodine, calcium, phosphorus, sodium, potassium, zinc, copper, magnesium, chlorine, fluorine and sulphur. The deficiency of minerals in the body causes many diseases. Minerals, however, do not supply any energy to our body. They are essential for the metabolic activities of the

contraction for certain tissues. Our body can use minerals in the compound form and not as pure elements. For example, we cannot eat sodium metal or chlorine gas in their element from as such; because they are toxic (poisonous) and can even kill a person. But their compound called sodium chloride is a mineral salt which is harmless and, in fact, essential for our body.

1.3.1.5.1 Sources of Mineralsz

We get most of the minerals form plant sources. This is because plants take the various minerals form the soil through their roots and supply them to man and animals through the food chain. So, even the minerals which we get from some animals are, in fact, derived form the plants which the animals eat. Source of common salt is Sodium chloride.

1.3.1.6 Water

Water is an inorganic substance made up of hydrogen & oxygen. Water is not considered a food because it does not give energy like carbohydrates & fats or builds body tissues like proteins. Water in however, an essential part of a man's diet because it help in preparing food for assimilation by the bodty. In fact, about two-third of man body weight is the water in the tissues of his body. Water place an important role in a large number of process like digestion, transport & helps in regulation of body temperature.

An important role of water in our body is to regulate the body temperature the process of sweating and evaporation. when the outside temperature is high, the water oozes out through the skin in the form of sweat. When this water evaporates from our body, it takes the latent heat of vaporization from skin. By losing heat, the skin cools down a little and we feel comfortable.

1.3.1.6.1 Sources of Water

The amount of water needed by body depends on one's age type of work, and the climate. Our body gets a lot of water from many of the food items which we eat. For example, fruits, vegetables, meat and fish give a lot of water to our body. Most of the water needed by our body, however, comes from the plain "drinking water", tea, coffee, milk etc.

Some of the water in our body comes as a byproduct of the oxidation of glucose during the metabolism of the food. In fact, 1 molecule of glucose on oxidation in the body produces 6 molecules of water.

1.3.1.7 Roughage

Though roughage is not a food, it is an important part of balanced diet. Roughage neither gives us energy like carbohydrates and fats, nor does it build our body like protein do, but it is important for the normal working of the digestive system. Roughage is the fibrous material present in plants and their products like fruits and vegetables. Roughage mainly consists of the indigestible plant carbohydrates called cellulose. But our body does not have enzymes to digest the cellulose. Cellulose remains undigested and being a fibrous material acts as roughage and keeps the digested system in order.

1.3.1.7.1 Sources of roughage

The sources of roughage in our food are: salad; vegetables & fruit with skin high fiber contents. Cabbage is one vegetable which provide us a lot of roughage. Corn cob & half - crushed, wheat also provide roughage to our body, along with other nutrients. All these food items have cellulose content which act as roughage. These fibrous materials are good for digestion and helps in bowel movement.

1.4. Concept of a balance diet

A balanced diet is one that fulfills all of a person's nutritional needs. Humans need a certain amount of calories and nutrients to stay healthy. A balanced diet provides all the nutrients a person requires. By eating a balanced diet, people can get the nutrients and calories they need. In addition, a balanced diet should provide other non-nutrients such as dietary fiber, antioxidants and phytochemicals which bestow positive health benefits.

A balanced *diet* includes foods from five groups. Eating a balanced diet helps people maintain good health and reduce their risk of disease.

The 5 food groups

A healthful, balanced *diet* includes foods from these five groups (Fig. 1.2):

a) vegetables

b) fruits

c) grains

d) protein : Animal (fish, meat, egg), plant (seeds, pulse)

e) dairy

Fig. 1.2 *showing different food groups*

a) Vegetables

The vegetable group includes five subgroups: leafy greens, red or orange vegetables, starchy vegetables, beans and peas (legumes), other vegetables, such as eggplant.

To get enough nutrients and keep dietary monotony, people should choose a variety of vegetables.

b) Fruits

A balanced diet also includes plenty of fruit. Instead of getting fruit from juice, nutrition experts recommend eating whole fruits.

Juice contains fewer nutrients. Also, the manufacturing process often adds empty calories due to added sugar. People should opt for fresh or frozen fruits, or fruits canned in water instead of syrup.

c) Grains

There are two subgroups: whole grains and refined grains.

Whole grains include all three parts of the grain, which are the bran, germ, and

endosperm. The body breaks down whole grains slowly, so they have less effect on a person's blood sugar. Additionally, whole grains tend to contain more fiber and protein than refined grains.

Refined grains are processed and do not contain the three original components. Refined grains also tend to have less protein and fiber, and they can cause blood sugar spikes.

At least half of the grains that a person eats daily should be whole grains. Healthful whole grains include: oats, brown rice, barley, buckwheat.

d) Proteins (Animal and Plant protein)

Nutritious protein choices include: lean beef and pork, chicken and turkey, fish, beans, peas, and legumes.

e) Dairy (Milk and Milk Product)

Dairy and (fortified)soy products are a vital source of calcium. Consumption of low-fat versions is recommended whenever possible.

Low-fat dairy and soy products include: cottage cheese, low-fat milk, yogurt and soy milk.

1.4.1 Importance of a balance diet

A balanced diet is important because the organs and tissues need proper nutrition to work effectively. Without good nutrition, the body is more prone to disease, infection, fatigue, and poor performance. Children with a poor diet run the risk of growth and developmental problems and poor academic performance, and bad eating habits can persist for the rest of their lives.

The following are the importance of a balanced diet:

1) Balanced diet leads to a good physical and a good mental health.
2) It helps in proper growth of the body.
3) Also, it increases the capacity to work.
4) Balanced diet increases the ability to fight or resist diseases.

1.5 Nutrient needs

This is a vast and never-ending task, given the large number of essential human nutrients. These nutrients include protein, energy, carbohydrates, fats and lipids, a range of vitamins, and a host of minerals and trace elements.

Many countries rely on WHO and FAa to establish and disseminate this information, which they adopt as part of their national dietary allowances. Others use it as a base for their standards. The establishment of human nutrient requirements is the common foundation for all countries to develop food-based dietary guidelines for their populations. Establishing requirements mean that the public health and clinical significance of intake levels - both deficiency and excess - and associated disease patterns for each nutrient need to be thoroughly reviewed for all age groups.

The subsequent recommended nutrient requirements included over twenty essential nutrients. These nutrients comprise the basis of all human nutrition: These include protein, energy, vitamin A and carotene, vitamin D, vitamin E, vitamin K, thiamine, riboflavin, niacin, vitamin B6, pantothenic acid, biotin, vitamin B12, folate, vitamin C, antioxidants, calcium, iron, zinc, selenium, magnesium and iodine.

The quantities of foods needed to meet the nutrient requirements vary with age, gender, physiological status and physical activity. The average person needs to eat about 2,000 calories (the number of calories in a food is a measurement of the amount of energy stored in that food) every day to maintain their weight. However, a person's specific daily calorie intake can also vary depending on their age, gender, and physical activity level. Men generally need more calories than women, and people who exercise need more calories than people who don't.

A balanced diet should provide around 50-60% of total calories from carbohydrates, preferably from complex carbohydrates, about 10-15% from proteins and 20-30% from both visible and invisible fat.

1.6 Dietary pattern

A dietary pattern is defined as the quantity, variety, or combination of different foods and beverage in a diet and the frequency with which they are habitually consumed. The nutrient requirements during the four main stages of the human lifecycle vary considerably. What infants and children require is different from what adults and the elderly need. In addition, there might be specific nutrients which a pregnant women and lactating mothers need in higher amounts than adult men.

Nutritional requirements in the different segments of the population thus can be classified into four groups. These correspond to different parts of the lifespan, na mely (a) pregnancy and lactation, (b) infancy and childhood (c) adolescence and adulthood, and (d) old age.

1.6.1 During pregnancy and lactation

An unborn child needs a healthy and well-nourished mother to grow properly. Therefore, a mother needs to gain weight during pregnancy to help nourish her growing baby. Women who do not gain enough weight often have babies that weigh too little (low birth weight). A baby weighing less than 2.5 kg has an increased chance of both physical and mental health problems. It may also suffer more from infection and malnutrition compared with babies of normal weight.

The increased requirement of nutrients during pregnancy and lactation are energy, protein, essential fatty acids, vitamin A, vitamin C, B vitamins (B1, B2, B3, B5, B6, B12, folate), calcium, phosphorus, iron, zinc, copper and iodine.

Women should gain at least 11 kg during pregnancy (Fig.1.3). If the mother gains less than this, the baby's chances of survival and health declines. If a mother is overweight, she still needs to gain for her baby's health. She should not try to lose weight while she is pregnant.

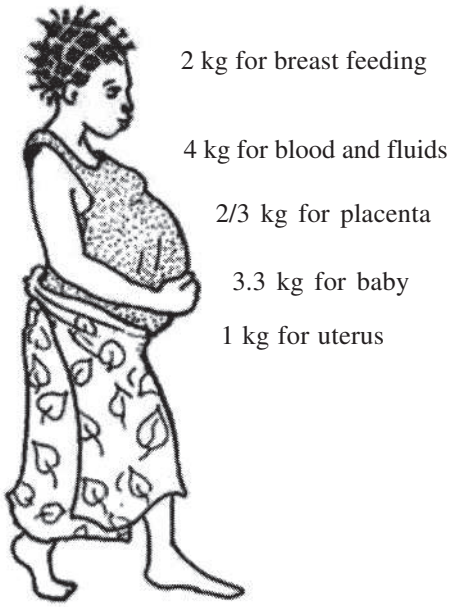

Fig.1.3 *Gaining weight during pregnancy*

1.6.1.1 Eating during pregnancy

Women's nutrition during pregnancy and lactation should focus on the three micronutrients (vitamin A, iron and iodine) and extra energy intake/reduction of

energy expenditure. Therefore the following are essential nutrition actions related to maternal nutrition:

i. A pregnant or breastfeeding woman needs extra foods, especially those that are good sources of iron.

ii. Pregnant women need at least one additional meal (200 Kcal) per day during the pregnancy.

iii. Pregnant women should eat iodised salt in their diet.

iv. Pregnant women should take vitamin A rich foods (such as papaya, mango, tomato, carrot, and green leafy vegetable) and animal foods (such as fish and liver).

v. Pregnant women need a well balanced diet containing mixture of foods. This should include as far as possible food from the different food groups (animal products, fruits, vegetables, cereals and legumes).

There is no need for high-priced foods! A pregnant or lactating woman can get extra foods by eating a little more of ordinary meals. She should increase the amount of nourishment at one or two meals, not every meal.

1.6.2 Nutrition during lactation (breast feeding) (Fig 1.4)

If all babies are to be healthy and grow well, they must be fed breast milk. When a baby sucks at the nipple, this causes the milk to come into the breast and continue to flow. Breast milk is food produced by the mother's body especially for the baby, and it contains all the nutrients (nourishment) a healthy baby needs.

A lactating woman needs at least two extra meals (550 Kcal) of whatever is available at home. In addition a dose of vitamin A (200,000 IU) should be given once between delivery and six weeks after delivery. This will enable the baby to get an adequate supply of vita min A for the first six months. During the first six months the best way of feeding the baby is for the mother to breastfeed exclusively.

In addition to extra meals and one high dose of vitamin A, a breastfeeding woman also needs:

a) Iodized salt in her diet

b) At least one liter of water per day

c) Vitamin A rich foods (such as papaya, mango, tomato, carrot and green leafy vegetables) and animal foods (such as fish and liver).

1.6.3 Nutritional requirements in infancy, childhood and adolescence (Fig 1.4)

The common feature of infancy, childhood and adolescence is that all these age groups are undergoing rapid growth and development. This in turn poses a heavy demand on their nutritional requirements. Small children and infants do not have a well developed body nutrient store, and therefore are more vulnerable to infection. In addition they have a larger surface area compared to their body size. All these factors increase their basal metabolic rate (BMR) resulting in an increased requirement for nutrients.

1.6.3.1 For school children

Maintaining a balanced diet and regular exercise is important for all individuals, especially school-aged children (6-12 years). These children are required to eat a variety of foods from each food group to ensure optimal intake of all vitamins and minerals. At the same time, they may face new challenges regarding food choices and habits. Decisions about what to eat are partly determined by what is provided in school, at home, the influences from friends at school, and the media, especially television.

Attaining optimal nutrition involves eating three meals a day and two nutritious snacks, as well as limiting the intake of high sugar and high fat foods. Consuming generous amounts of fruits, vegetables, lean meats and low fat dairy products, including three servings of milk, cheese or yoghurt to meet their calcium requirement, can also prevent many medical problems.

School-aged children grow significantly, but at slower rate, whilst being very physically active in general. As a result, their nutritional needs are high and critical. Additionally, genetic background, gender, body size and shape are all important determinants of nutrient requirements. The essential nutrients for optimal health are: Energy (carbohydrates and fats), protein, essential fatty acids, calcium and iron.

1.6.3.2 Adolescent growth spurt (Fig 1.4)

Adolescents also undergo a very rapid growth during their puberty (called the **pubertal growth spurt**). During the pubertal growth spurt, they increase rapidly

both in weight and height. Therefore, they need a nutrient intake that is proportional with their rate of growth. The growth rate is very high right after birth (infancy). Then the growth rate slows down until the age of 12-14 years. At about 15-16 years (the pubertal period) there is a sharp rise in growth rate/velocity. After that, the growth rate slows down again.

Requirements for macronutrients (proteins, carbohydrates and fats) and micronutrients are higher on a per kilogram basis during infancy and childhood than at any other developmental stage. These needs are influenced by the rapid cell division occurring during growth, which requires protein, energy and fat. Increased needs for these nutrients are reflected in daily requirements for these age groups, some of which are briefly discussed below.

Energy

While most adults require 25-30 calories per kg, a 4 kg infant requires more than 100 kilocalories per kg (430 calories/day). Infants of four to six months who weigh 6 kg require roughly 82 kilocalories per kg (490 calories/day). Energy needs remain high through the early formative years. Children of one to three years require approximately 83 kilocalories per kg (990 calories/day). Energy requirements decline thereafter and are based on weight, height, and physical activity.

Higher intakes of protein and energy for growth are recommended for adolescents. For most micro nutrients, recommendations are the same as for adults. Exceptions are made for certain minerals needed for bone growth (e.g. calcium and phosphorus). Evidence is clear that bone calcium accretion increases as a result of exercise rather than from increases in calcium intake. Since weight gain often begins during adolescence and young adulthood, young people must establish healthy eating and lifestyle habits that reduce the risk for chronic disease later in life.

Water

Infants and children need plenty of water to drink, particularly when ill, or exposed to extreme temperatures.

Essential fatty acids

Requirements for fatty acids or fats on a per kilogram basis are higher in infants than adults. Some fatty acids playa key role in the central nervous system. However

infants and children should not ingest large amounts of foods that contain predominantly fats, so it is important to get the balance right.

Increased nutrients required for energy during infancy and childhood is protein, essential fatty acids, calcium and phosphorus and in adolescence it is protein, calcium, phosphorus and zinc.

1.6.4 During adulthood (Fig 1.4)

The nutritional needs in adults of 19-50 years of age differ slightly according to gender. Males require more of vitamins C, K, Bl, B2 and B3, and zinc. Females require more iron, compared with males of similar age.

As we get older our bodies have different needs, so certain nutrients become especially important for good health.

Calcium and Vitamin D

Older adults need more calcium and vitamin D to help maintain bone health. Have three servings of calcium-rich foods and beverages each day. This includes fortified cereals and fruit juices, dark green leafy vegetables, fish with soft bones, milk and fortified plant beverages.

Vitamin B_{12}

Many people older than 50 do not get enough vitamin B12. Fortified cereal, lean meat and some fish and seafood are sources of vitamin B12.

Fiber

Fiber also can help lower the risk for heart disease and prevent Type 2 diabetes. Whole-grain breads and cereals, and more beans and peas, along with fruits and vegetables also provide fiber.

Potassium

Increasing potassium along with reducing sodium (salt) may lower the risk of high blood pressure. Fruits, vegetables and beans are good sources of potassium.

Fats

Foods that are low in saturated fats and trans fat help reduce the risk of heart disease. Most of the fats should be polyunsaturated and monounsaturated fats, which are primary found in nuts, seeds, avocados, olive oil and fish.

Fig 1.4 *Diet in different stages of life*

1.6.5 For elderly people (Fig 1.4).

Elderly people are especially vulnerable to nutritional problems due to age related changes in their body (impaired physiological and anatomical capacity).

An elderly person requires less energy than a younger individual due to reductions in muscle mass and physical activity. Some daily requirements for elderly people differ from those of younger adults. For example, in order to reduce the risk for age related bone loss and fracture, the requirement for vitamin D is increased from 200

IU/day to 400 in individuals of 51-70 years of age and to 600 IU/day for those over 70 years of age. Suggested iron intakes reduce however from 18 mg per day in women aged 19-50 to 8 mg/day after age 50, due to better iron conservation and decreased losses in postmenopausal women compared with younger women.

Some elderly people have difficulty getting adequate nutrition because of age or disease related impairments in chewing, swallowing, digesting and absorbing nutrients. Their nutrient status may also be affected by decreased production of chemicals to digest food (digestive enzymes), changes in the cells of the bowel surface and drug-nutrient interactions. Some elderly people demonstrate selenium deficiency, a mineral important for immune function. Impaired immune function affects susceptibility to infections and tumours (malignancies). Vitamin B6 helps to boost selenium levels, so a higher intake for people aged 51-70 is recommended.

Fruits and vegetables are very nutrient rich, and contain many cancer fighting antioxidants. They also contain fiber, which helps maintain bowel regularity.

Low-fat dairy products, leafy greens, and fish with soft bones provide needed *calcium* to help keep the bones strong.

Vitamin B12 helps in the production of red blood cells, and it also keeps the brain and nervous system healthy. B12 is available in animal products like meat, fish, and dairy.

1.7 Summary

I. The major components of foodstuffs are moisture, lipids, protein, fiber, carbohydrate, minerals and vitamins.

II. A diet is all that we consume in a day. And a balanced diet is a diet that contains an adequate quantity of the nutrients that we require in a day. A balanced diet includes six main nutrients, i.e. Fats, Protein, Carbohydrates, Fiber, Vitamins, and Minerals.

III. In addition, a balanced diet should provide other non-nutrients such as dietary fiber, antioxidants and phytochemicals which bestow positive health benefits.

IV. Dietary patterns are the quantities, proportions, variety or combination of different foods, drinks, and nutrients in diets, and the frequency with which they are habitually consumed.

V. Different food items have different proportions of nutrients present in them. The requirements of the nutrients depend on the age, gender, and health of a person.

VI. Dietary guidelines change over time. Current recommendations suggest that a person's plate should contain primarily vegetables and fruits, some lean protein, some dairy and soluble fiber.

Questions

1. What are the major food constituents?
2. Define balance diet.
3. State importance of balance diet.
4. What are the sources of carbohydrates?
5. Give nutritional requirements of an elderly people.
6. What types of foods are required for a pregnant mother?

Unit- 2 ❑ Nutritional Biochemistry

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2.8 Summary

2.1 Objectives

This unit of the food, nutrition and health covering the aspects of nutritional biochemistry gives a clear idea about the chemistry of the macromolecules present in the food you take regularly. After completion of the topic of interest the reader would be able to

- Describe the different types of macromolecules along with their dietary source
- Explain the role of individual macromolecule.
- Describe different types of vitamins along with their dietary source and the benefits of use of vitamins.
- Describe the role of different minerals in body functions.

2.2 Introduction

Carbohydrates, lipids, proteins and nucleic acids are called macromolecules because of their large size and they are needed in large amount. When these food are digested they get broken down into the subunit molecules as monosaccharide, glycerol and fatty acids, amino acids and nucleotide respectively. Body then takes these subunits and builds from them the macromolecules that make up your cells.

The largest of the macromolecules are called polymers because they are constructed by linking together a large number of the same type of subunits called monomers. A protein can contain hundreds of amino acids and a nucleic acid can contain hundreds of nucleotides. The polymers get so large by using modular approach of the cells for constructing polymers. It is just a train increases in length when an wagon hitched together one by one, so a polymer gets longer as monomers bond to one another.

Organic molecules are routinely built up in cells by the removal of water (H_2O) during a dehydration reaction. They are degraded in cells by the addition of water during a hydrolysis reaction. For all these reactions to occur in a cell, an enzyme must be present. The enzyme is a molecule that speeds a reaction by bringing the reactants together and the enzyme may even participate in causing the reaction to occur.

Micronutrients like vitamins and minerals are needed in small amount but are essential for health.

2.3 Carbohydrates

Carbohydrates are probably the most abundant and widespread organic substances in nature, and they are essential constituents of all living things. Carbohydrates are formed by green plants from carbon dioxide and water during the process of photosynthesis. Carbohydrates serve as energy sources and as essential structural components in organisms; in addition, part of the structure of nucleic acids, which contain genetic information, consists of carbohydrate.

2.3.1 Definition

Carbohydrates are a large group of organic compounds occurring in foods and living tissues including sugars, starch, and cellulose. They contain hydrogen and oxygen in the same ratio as water (2:1) and typically can be broken down to release energy in the animal body.

2.3.2 Classification

Although a number of classification schemes have been devised for carbohydrates, the division into four major groups-monosaccharide, disaccharides, oligosaccharides, and polysaccharides-used here is among the most common.

Most **monosaccharide,** or simple sugar are found in grapes, other fruits, and honey. Although they contain from three to nine carbon atoms, the most common representatives consist of five or six joined together to form a chain like molecule. Three of the most important simple sugars—glucose also known as dextrose (grape sugar, and corn sugar), fructose (fruit sugar), and galactose—have the same molecular

formula, ($C_6H_{12}O_6$), (Fig.2.1) but, because their atoms have different structural arrangements, the sugars have different characteristics; i.e., they are isomers.

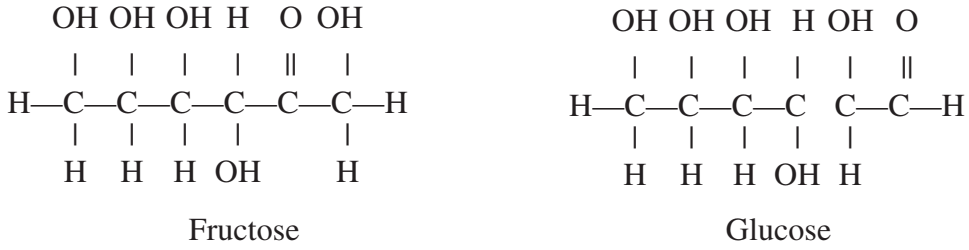


Fig. 2.1 *Chemical structure of Fructose and Glucose*

Slight changes in structural arrangements are detectable by living things and influence the biological significance of isomeric compounds. It is known, for example, that the degree of sweetness of various sugars differs according to the arrangement of the hydroxyl groups (– OH) that compose part of the molecular structure. A direct correlation that may exist between taste and any specific structural arrangement, however, has not yet been established; that is, it is not yet possible to predict the taste of a sugar by knowing its specific structural arrangement. The energy in the chemical bonds of glucose indirectly supplies most living things with a major part of the energy that is necessary for them to carry on their activities. Galactose, which is rarely found as a simple sugar, is usually combined with other simple sugars in order to form larger molecules.

Two molecules of a simple sugar that are linked to each other form a **disaccharide**, or double sugar. The disaccharide **sucrose**, or table sugar, consists of one molecule of glucose and one molecule of fructose; the most familiar sources of sucrose are sugar beets and cane sugar. Milk sugar, or **lactose**, and **maltose** are also disaccharides. Before the energy in disaccharides can be utilized by living things, the molecules must be broken down into their respective monosaccharides.

Oligosaccharides, which consist of three to six monosaccharide units, are rather infrequently found in natural sources, although a few plant derivatives have been identified.

Polysaccharides (the term means many sugars) represent most of the structural and energy-reserve carbohydrates found in nature. Large molecules that may consist

of as many as 10,000 monosaccharide units linked together. Polysaccharides vary considerably in size, in structural complexity, and in sugar content; several hundred distinct types have thus far been identified.

Cellulose, the principal structural component of plants, is a complex polysaccharide comprising many glucose units linked together (Fig. 2.2); it is the most common polysaccharide. The starch found in plants and the glycogen found in animals, also are complex glucose polysaccharides. Starch (from the Old English word *stercan,* meaning "to stiffen") is found mostly in seeds, roots, and stems, where it is stored as an available energy source for plants. Plant starch may be processed into foods such as bread, or it may be consumed directly-as in potatoes, for instance. Glycogen" which consists of branching chains of glucose molecules, is formed in the liver and muscles of higher animals and is stored as an energy source.

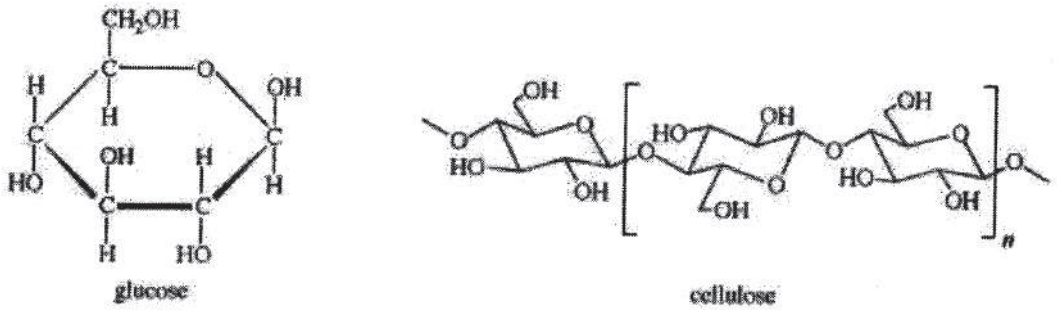


Fig. 2.2 *Chemical composition of cellulose and glucose*

2.3.3 Dietary source of Carbohydrates

Most dietary carbohydrates come from plants. Sugars and starches are nutritive carbohydrates, meaning they are broken down and utilized by the body, primarily to generate energy. Although dietary fiber is also a carbohydrate, it contributes no calories because it is not digested or absorbed. Aside from lactose found in milk and small amounts of specific sugars in red meat, almost all dietary carbohydrates come from plant foods. These foods will often be made up of a combination of the different types of carbohydrates in varying amounts.

Below is a brief overview of the most common dietary sources for the different types of carbohydrates. (Table 2.1)

Table 2.1 Dietary Sources of Carbohydrate

MONOSACCHARIDES	
Fructose	Fruits, vegetables and honey Also derived from the digestion of sucrose
Glucose	Small amounts are found in some fruits, vegetables and honey, Manufactured foods Digestion and conversion of other carbohydrates
Galactose	Digestion of lactose
DISACCHARIDES	
Sucrose	Derived from sugar cane and sugar beet Sweet root vegetables such as beetroot and carrots Table sugar, manufactured foods
Maltose	Malted wheat and barley, Malt extract, Beer
Lactose	Milk Milk products
Trehalose	Mushrooms and edible fungi
OLIGOSACCHARIDES	
Raffinose, stachyose, verbascose, inulin, fructo and galacto-oligosaccahrides	Legumes Onion, artichoke, fennel, asparagus Pro-biotics
POLYSACCHARIDES	
Starch	Cereal foods, Potato Small amounts in other root vegetables and unripe fruit
Non-starch	Vegetables, fruit
Polysaccharides	Whole grain cereals Pulses

2.3.4 Role of Carbohydrates

Already it was stated that carbohydrates are molecules that contain carbon,

hydrogen and oxygen atoms in specific ratios. But in the nutrition world, they're one of the most controversial issues. Some believe eating fewer carbohydrates is the way to optimal health, while others prefer higher-carb diets. Still, others insist moderation is the way to go. Within this juncture it's hard to deny that carbohydrates play an important role in the human body.

1. One of the primary functions or roles of carbohydrates is to provide the body with energy. Most of the carbohydrates in the foods taken are digested and broken down into glucose before entering the bloodstream. Glucose in the blood is taken up into body's cells and used to produce a fuel molecule called adenosine triphosphate (ATP) through a series of complex processes known as cellular respiration. Cells can then use ATP to power a variety of metabolic tasks.
2. They also provide stored energy. If the body has enough glucose to fulfill its current needs, excess glucose can be stored for later use. This stored form of glucose is called glycogen and is primarily found in the liver and muscle. The liver contains approximately 100 grams of glycogen. These stored glucose molecules can be released into the blood to provide energy throughout the body and help maintain normal blood sugar levels between meals.

   Unlike liver glycogen, the glycogen in your muscles can only be used by muscle cells. It is vital for use during long periods of high-intensity exercise.
3. When glucose from carbohydrates is lacking, muscle can also be broken down into amino acids and converted into glucose or other compounds to generate energy.
4. Consuming at least some carbohydrates in the diet is one way to prevent starvation-related loss of muscle mass. These carbs will reduce muscle breakdown and provide glucose as energy for the brain.
5. Some promote digestive health. Unlike sugars and starches, dietary fiber is not broken down into glucose. Soluble fiber is found in oats, legumes and the inner part of fruits and some vegetables. While passing through the body, it draws in water and forms a gel-like substance. This increases the bulk of your stool and softens it to help make bowel movements easier.
6. Eating plenty of dietary fiber can benefit heart and blood sugar levels.

2.4 Lipids

Although the term "lipid" is sometimes used as a synonym for fats, fats are a subgroup of lipids called triglycerides. Lipids also encompass molecules such as fatty acids and their derivatives (including tri-, di-, monoglycerides and phospholipids), as well as other sterol-containing metabolites such as cholesterol. Although humans and other mammals use various biosynthetic pathways to break down and to synthesize lipids, some essential lipids can't be made this way and must be obtained from the diet.

2.4.1 Definition

A lipid is chemically defined as a substance that is insoluble in water and soluble in alcohol, ether, and chloroform. These solubility criteria are not absolute. Lipids were therefore defined as compounds containing in their molecule an aliphatic chain (chain consisting of $-CH_2-$) of at least 8 carbon atoms. Some short-chain fatty acids (like butyric acid, in C_4) are the only exceptions to this rule.

Lipids are an important component of living cells. Together with carbohydrates and proteins, lipids are the main constituents of plant and animal cells.

Cholesterol and triglycerides are lipids. Lipids are easily stored in the body. They serve as a source of fuel and are an important constituent of the structure of cells.

Lipids include fatty acids, neutral fats, waxes and steroids (like cortisone). Compound lipids (lipids complexed with another type of chemical compound) comprise the lipoproteins, glycolipids and phospholipids.

2.4.2 Classification

Lipids may be classified based on their physical properties at room temperature (solid or liquid, respectively fats and oils), on polarity, or on their essentiality for humans, but the preferable classification is based on their structure.

Based on structure, they can be classified in four major groups: Fatty acids, Glycerolipids, Sphingolipids and Cerides.

2.4.2.1 Fatty Acids:

They are found in small quantities in free state, but in large quantities involved in ester (or sometimes amide) linkages. As a general rule, these are monocarboxylic, straight unbranched chain acids containing an even number of carbon atoms (between

4 and 36). They may be saturated or unsaturated and sometimes hydroxylated or branched.

2.4.2.1.1 Saturated Fatty Acids:

Their general formula is: $CH_3 – (CH_2)_n – COOH$. The most frequent are palmitic acid (C_{10}) and stearic acid (C_{18}). In lower concentration are found the fatty acids with 14 or 20 carbon atoms. Longer fatty acids (up to 36 carbon atoms) are present in numerous cells (bacteria, unicellular eucaryotes, plants, vertebrates).

They are generally present in some types of lipids. Milk on the contrary, is rich in short-chain fatty acids. Besides the even-carbon fatty acids, are generally found small quantities of fatty acids having 15, 17 or 19 carbon atoms.

2.4.2.1.2 Unsaturated Fatty Acids:

Fatty acids are numbered from the terminal carboxyl (carbon 1) to the CH_3 group (carbon n). The double bond is indicated by the sign Δ, accompanied by the number corresponding to the first carbon atom participating in the double bond. The sign: is being increasingly used; it is followed by the number of double bonds, the position of the latter being indicated within brackets. Also omega 3 (ω3) fatty acids have double bond three carbon from the methyl moiety in their chemical structure.

The principal unsaturated fatty acids are:

A. Monounsaturated Fatty Acids (1 Double Bond):

Oleic acid (C_{18}), double bond between carbon atoms C_9 and C_{10}, abbreviated as: (C_{18}, Δ^9 or 18 :1(9) or 18 ω 9).

CH_3-$(CH_2)_7$-CH = CH-$(CH_2)_7$-COOH

B. Polyunsaturated Fatty Acids (Several Double Bonds):

In the most common of such acids, the non-conjugated double bonds are separated by a methylene group. Plants can however contain fatty acids with conjugated double bonds, for example, eleostearic acid.

Linoleic acid (C_{18}, $\Delta^{9,12}$ or 18:2 (9,12) or 18 ω 6)

CH_3-$(CH_2)_4$-CH = CH-CH_2-CH = CH-$(CH_2)_7$-COOH

Linolenic acid (C_{18}, $\Delta^{9,12,15}$ or 18 : 3 (9,12,15) or 18 ω 3)

$CH_3–CH_2–CH = CH–CH_2–CH = CH–CH_2–CH = CH–(CH_2)_7–COOH$

Arachidonic acid (C_{20} $\Delta^{5,8,11,14}$).

Docosahexaenoic acid (C_{22} $\Delta^{4,7,10,13,16,19}$).

Eleostearic acid (C_{18}, $\Delta^{9,11,3}$).

In mammals, polyunsaturated fatty acids can have up to 22 carbon atoms and 6 double bonds, but in plants these acids do not exceed 18 carbon atoms and 4 double bonds.

An important physical property of fatty acids is their melting point; it decreases with increasing number of double bonds. For example, the melting point of stearic acid (18: 0) is 70°C, whereas that of oleic acid (18 :1) is 13°C, that of linoleic acid (18: 2), – 5.8°C and that of arachidonic acid (20: 4), – 49.5°C.

2.4.2.1.3 Hydroxylated Fatty Acids:

Plants can synthesize a series of hydroxylated fatty acids like ricinoleic acid for example:

$$CH_3 - (CH_2)_5 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_2 - CH = CH - (CH_2)_7 - COOH$$

Some of these hydroxylated fatty acids lead to the formation of cutin. Other types of hydroxylated fatty acids are found in mammals. Some glycolipids contain large quantities of α-hydroxylated acids (OH on carbon 2) with 22, 23, 24 and 25 carbon atoms. Moreover, cells of the epiderm have lipids containing very long-chain ω hydroxylated acids which play a role in the structure of this particular tissue.

2.4.2.1.4 Branched Fatty Acids :

Example: 15 methyl hexadecaenoic acid $(CH_3)_2 - CH - (CH_2)_{13} - COOH$

The above type of fatty acid is particularly abundant in Gram$^+$ bacteria.

2.4.2.1.5 Prostaglandins, Leukotriens :

Prostaglandins and leukotriens (Fig. 2.3) are derived from polyunsaturated fatty acids with 20 carbon atoms ω 6 and ω 3 (hence their general name, eicosanoids) and especially from arachidonic acid, under the action of cyclooxygenase (prostaglandines) and lipoxygenase (Leukotriens).

In mammals, these are compounds having hormonal action with various biological

effects. Prostaglandines E are powerful activators of adenylate cyclase. Prostaglandines F and leukotriens B, C, D, activate the contraction of various smooth muscles.

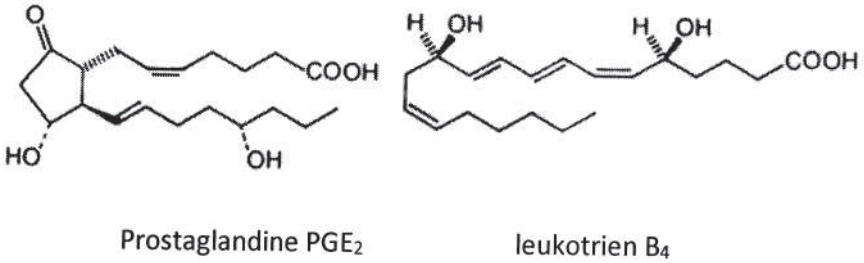


Fig. 2.3 *Structure of prostaglandins and leukotriens*

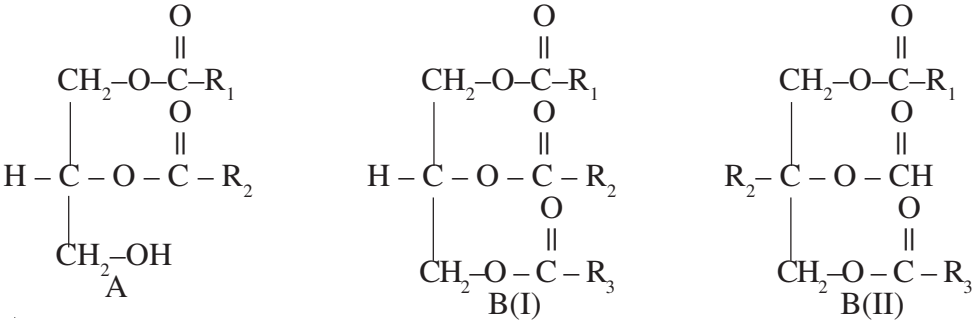
2.4.2.1.6 Other Close Compounds:

Besides the fatty acids, one finds aldehydes and fatty alcohols, such as for example, palmitaldehyde, stearaldehyde, olealdehyde and the corresponding primary alcohols. These compounds are rarely in free state, but are part of the structure of glycerophospholipids or cerides. Medium- chain linear aldehydes play a role of pheromone in insects.

2.4.2.2 Glycerolipids:

2.4.2.2.1 Glycerides:

These compounds are obtained by esterification of the alcohol groups of glycerol by fatty acids; there are mono-, di- and triglycerides. Moreover, glycerides may differ by the nature and position of esterified fatty acids. To indicate the position, the carbon atoms of glycerol are denoted 1,2 and 3. Thus, the compound A of fig.2.4 is 1-palmitoyl 2-oleyl glycerol, compound B is 1-palmitoyl 2-oleyl-3-stearoyl glycerol.



$$\begin{bmatrix} R_1 = -(CH_2)_{14} - CH_3 \\ R_3 = -(CH_2)_{16} - CH_3 \end{bmatrix} \qquad R_2 = (CH_2)_7 - CH = CH-(CH_2)_7-CH_3$$

Fig.2.4 *Structure of di- and triglycerides*

When the fatty acids esterified in position 1 and 3 are different (as in the compound B), a centre of asymmetry appears in carbon 2 and one can therefore have the isomers I and II represented in Fig. 2.4. Most of the natural glycerolipids are of type II.

2.4.2.2.2 Glycerophospholipids:

Also called phosphatides they are the most numerous representatives of the large family of phospholipids. They are found in high concentrations in the cellular and subcellular membranes of all living organisms.

A. Diacylphosphatides:

a) Phosphatide Acids:

They result from the esterification of glycerol by two fatty acids and phosphoric acid; the latter having only one of its acidic OH esterified, imparts an acid character to the molecule .They exist in small quantities in free state and play an important role in the biosynthesis of glycerophospholipids.

b) Phosphatidyl Cholines (Lecithins):

These compounds contain a molecule of choline (a quaternary ammonium compound having an alcohol group) esterified by phosphoric acid which is therefore involved in a phosphodiester linkage.

c) Other Phosphatides:

In these compounds, which are very similar to lecithins, choline is replaced by:

(i) Ethanolamine in phosphatidyl ethanolamines

(ii) Serine in phosphatidyl serines

These two types of lipids were earlier called “cephalins”.

B. Alkenylphosphatides (Plasmalogens):

They differ from diacyphosphatides in that the fatty acid bound in position 1 of the glycerophosphate is replaced by a fatty aldehyde, bound by an ethylcnic ether-oxide linkage.

C. Alkylphosphatides (Etherphosphatides):

They are distinguished from diacylphosphatides by the fact that the fatly acid in 1 is replaced by a fatty alcohol bound by an ether-oxide linkage.

2.4.2.2.3 Glycosyldiglycerides:

They result from the binding of one or several (up to 10) molecules of monosaccharides to the free alcohol group of a 1, 2-diglyceride. The most frequent monosaccharides are galactose and glucose. The mono- and di-galactosyldiglycerides are important compounds of chloroplasts. The glucosyl- and galactosyldiglycerides are major constituents of the plasmic membrane of numerous bacteria. Glycosyldiglycerides were also found in some secretions (tears, saliva, gastric secretions) of mammals.

2.4.2.3 Sphingolipids:

In these compounds the alcohol is not glycerol but a long-chain amino- alcohol. The most frequent is sphingosine which has 18 carbon atoms and a double bond. Dihydrosphingosine (saturated sphingosine) and phytos- phingosine (saturated sphingosine with an additional alcohol group) are also found but less frequently.

Sphingosine is linked to a fatty acid by its amine group forming a ceramide. The linkage is therefore an amide bond and not an ester bond as in glycerides, sterides or phosphatides. The fatty acid of sphingolipids can be a long-chain fatty acid with or without a hydroxyl group on carbon 2. The ceramides are found in small quantities, in free state, in numerous eucaryotic and procaryotic cells.

2.4.2.3.1 Sphingomyelins:

The ceramide is linked by its primary alcohol group (carbon 1) to a phosphorylcholine. Sphingomyelins have been found in most organisms. They are present, like the phosphatides, in cellular membranes and particularly in the plasmatic membrane.

2.4.2.3.2 Sphingoglycolipids:

These are lipids characterized by the presence in their molecule, of one or more saccharides linked to the carbon 1 of a ceramide.

A. Galactolipids:

In the case of galactocerebrosides, the monosaccharide fixed on the ceramide is galactose. Galactose can be esterified by a molecule of sulphuric acid. The compounds are then called sulphatides. In mammals, galactocerebrosides and sulphatides are mainly located in the renal tissue and nervous tissue (myelin sheath).

B. Neutral Glycolipids:

One or several (up to about ten) sugars are bound to the ceramide. In vertebrates, the first sugar is glucose. The compounds are then spoken of as glucocerebrosides.

In addition to glucose, the most frequently found monosaccharides are galactose, mannose, fucose, glucosamine and galactosamine. Neutral glycolipids particularly the glucocerebrosides are present in a very large number of organisms ranging from the procaryotes to mammals where they can form up to 90% of lipids.

C. Gangliosides:

Their structure is that of a glucosylceramide to which are bound one or several molecules of galactose, N-acetyl galactosamine, N-acetylglucosamine or fucose. The most characteristic sugar of gangliosides is however neuraminic acid (or sialic acid) in the N-acetylated or N-glycosylated form. They are found only in vertebrates. The brain is particularly rich in gangliosides.

D. Phytoglycolipids:

Besides the conventional neutral glycolipids, most plants, yeasts and fungi include more complex glycolipids which generally contain phosphorus and inositol, as for example, ceramide-phosphate-inositol-glucuronic acid- glucosamine-mannose.

2.4.2.4 Cerides:

These are constituents of waxes (plant waxes, insect waxes, sperm oil, etc.). They are esters formed by the union of long-chain fatty acids and long-chain alcohols (having up to 30 to 40 carbon atoms). Example: cetyl palmitate (Fig. 2.5).

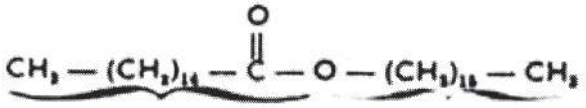


Fig. 2.5 *Structure of cetyl palmitate*

Some lipids can be considered as derivatives of isoprene (steroids, carotenoids, quinones with isoprenic side chain).

Steroids are a naturally occurring family of organic molecules of biochemical and medical interest. The steroids are members of a large, diverse collection of lipids called the isoprenoids. All of these compounds are built from one or more five-carbon units called isoprene.

2.4.3 Dietary source of lipids

Unsaturated fats

Unsaturated fats, which are liquid at room temperature, are considered beneficial fats because they can improve blood cholesterol levels, ease inflammation, stabilize

heart rhythms, and playa number of other beneficial roles. Unsaturated fats are predominantly found in foods from plants, such as vegetable oils, nuts, and seeds.

There are two types of "good" unsaturated fats:

Monounsaturated fats are found in high concentrations in:

i) Olive, peanut, and canola oils

ii) Avocados

iii) Nuts such as almonds, hazelnuts, and pecans

iv) Seeds such as pumpkin and sesame seeds

Polyunsaturated fats are found in high concentrations in

i) Sunflower, corn, soybean, and flaxseed oils

ii) Walnuts

iii) Flax seeds

iv) Fish

v) Canola oil- though higher in monounsaturated fat, it's also a good source of polyunsaturated fat.

Omega-3 fats are an important type of polyunsaturated fat. The body can't make these, so they must come from food.

i) An excellent way to get omega-3 fats is by eating fish 2-3 times a week.

ii) Good plant sources of omega-3 fats include flax seeds, walnuts, and canola or soybean oil.

Saturated Fats

All foods containing fat have a mix of specific types of fats. Even healthy foods like chicken and nuts have small amounts of saturated fat, though much less than the amounts found in beef, cheese, and ice cream. Saturated fat is mainly found in animal foods, but a few plant foods are also high in saturated fats, such as coconut, coconut oil, palm oil, and palm kernel oil.

The biggest sources of saturated fat in the diet are

i) Pizza and cheese

ii) Whole and reduced fat milk, butter and dairy desserts

iii) Meat products (sausage, bacon, beef, hamburgers)

iv) Cookies and other grain-based desserts

v) A variety of mixed fast food dishes

Animal-based products:

Dairy foods - such as butter, cream, full fat milk and cheese

Meat - such as fatty cuts of beef, pork and lamb and chicken (especially chicken skin), processed meats like salami.

Some plant-derived products:

Palm oil

Coconut

Coconut milk and cream

Cooking margarine

Many manufactured and packaged foods:

Fatty snack foods (such as potato chips, savoury crackers)

Deep fried and high fat take away foods (such as hot chips, pizza, hamburgers)

Cakes and high fat muffins

Pastries and pies (including quiche, tarts, sausage rolls, pasties, croissants)

Sweet and savoury biscuits

Trans Fats

Trans fatty acids, more commonly called trans fats, are made by heating liquid vegetable oils in the presence of hydrogen gas and a catalyst, a process called hydrogenation. Partially hydrogenating vegetable oils makes them more stable and less likely to become rancid. This process also converts the oil into a solid, which makes them function as margarine or shortening. Partially hydrogenated oils can withstand repeated heating without breaking down, making them ideal for frying fast foods.

Partially hydrogenated oil is not the only source of trans fats in our diets. Trans fats are also naturally found in beef fat and dairy fat in small amounts.

2.4.4 Role of lipids

1) **Storing energy** - The excess energy from the food we eat is digested and incorporated into adipose tissue, or fatty tissue. Most of the energy required by the human body is provided by carbohydrates and lipids. Glucose as carbohydrate is stored in the body as glycogen. While glycogen provides a ready source of energy, lipids primarily function as an energy reserve. A fat gram is densely concentrated with energy-it contains more than double the amount of energy than a gram of carbohydrate. Energy is needed to power the muscles for all the physical work. A serious impact of excess fat is the accumulation of too much cholesterol in the arterial wall, which can thicken the walls of arteries and lead to cardiovascular disease.

2) **Regulating and signaling** - Triglycerides control the body's internal climate, maintaining constant temperature. Those who don't have enough fat in their bodies tend to feel cold sooner, are often fatigued, and have pressure sores on their skin from fatty acid deficiency.

Triglycerides also help the body produce and regulate hormones. For example, adipose tissue secretes the hormone leptin, which regulates appetite. In the reproductive system, fatty acids are required for proper reproductive health. Women who lack proper amounts may stop menstruating and become infertile.

Omega-3 and omega-6 essential fatty acids help regulate cholesterol and blood clotting and control inflammation in the joints, tissues, and bloodstream.

Fats also play important functional roles in sustaining nerve impulse transmission, memory storage, and tissue structure.

3) **Insulating and protecting** - Vital organs such as the heart, kidneys, and liver are protected by visceral fat.

4) **Aiding digestion and increase bioavailability** - The dietary fats in the foods we eat break down in our digestive systems and begin the transport of precious micronutrients. By carrying fat-soluble nutrients through the digestive process, intestinal absorption is improved. This improved absorption is also known as increased bioavailability.

Fat-soluble nutrients are especially important for good health and exhibit a variety of functions. Vitamins A, D, E, and K-the fat-soluble vitamins-are mainly found in

foods containing fat. Some fat-soluble vitamins (such as vitamin A) are also found in naturally fat-free foods such as green leafy vegetables, carrots, and broccoli.

Fats also increase the bioavailability of compounds known as phytochemicals, which are plant constituents such as lycopene (found in tomatoes) and beta-carotene (found in carrots).

2.5 Proteins

Protein, highly complex substance that is present in all living organisms. Proteins are of great nutritional value and are directly involved in the chemical processes essential for life. The importance of proteins was recognized by chemists in the early 19th century, including Swedish chemist Ions Jacob Berzelius, who in 1838 coined the term *protein,* a word derived from the Greek *proteios,* meaning "holding first place." Proteins are species-specific; that is, the proteins of one species differ from those of another species. They are also organ-specific; for instance, within a single organism, muscle proteins differ from those of the brain and liver.

Proteins are required for the structure, function, and regulation of the body's cells, tissues, and organs. Each protein has unique functions. Proteins are essential components of muscles, skin, bones and the body as a whole. Proteins are one of the three types of nutrients used as energy sources by the body, the other two being carbohydrate and fat. Proteins and carbohydrates each provide 4 kalories of energy per gram, while fats produce 9 kcalories per gram.

2.5.1 Definition

A protein is a substance that is made up of amino acids. They contain carbon, hydrogen, oxygen, nitrogen and sometimes sulfur and is found in many foods. An example of a protein is the type of nutrient found in meats.

2.5.2 Classification

Proteins are classified based upon:

(1) Their solubility and

(2) Their structural complexity.

2.5.2.1 Classification Based upon Solubility:

On the basis of their solubility in water, proteins are classified into:

1. Fibrous proteins:

These are insoluble in water. They include the structural proteins. They have supportive function (e.g., collagen) and/or protective function (e.g., hair keratin and fibrin).

2. Globular proteins:

They are soluble in water. They include the functional proteins, e.g., enzymes, hemoglobin, etc.

2.5.2.2 Classification Based upon Structural Complexity:

On the basis of their structural complexity proteins are further divided into:

(1) Simple

(2) Conjugated

(3) Derived proteins.

1. Simple proteins:

Proteins which are made up of amino acids only are known as simple proteins. They are further sub-divided into:

(a) Albumins:

They dre water soluble, heat coagulable and are precipitated on full saturation with ammonium sulphate, e.g., serum albumin, lactalbumin and ovalbumin.

(b) Globulins:

They are insoluble in water, but soluble in dilute salt solutions. They are heat coagulable and precipitate on half-saturation with ammonium sulphate, e.g., serum globulin and ovo-globulin.

(c) Glutelins:

They are insoluble in water and neutral solvents. Soluble in dilute acids and alkalies. They are coagulated by heat, e.g., glutelin of wheat.

(d) Prolamines:

Water insoluble but soluble in 70% alcohol, e.g., gliadin of wheat, proteins of corn, barley, etc. This protein have a high proline amino and content.

(e) Histones:

Water soluble, basic in nature due to the presence of arginine and lysine, found in nucleus. They help in DNA packaging in the cell. They form the protein moiety of nucleoprotein.

(f) Protamines:

Water soluble, basic in nature, not-heat coagulable. Found in sperm cells, hence component of sperm nucleoprotein.

(g) Globins:

They are water soluble, non-heat coagulable. e.g., globin of haemoglobin.

(h) Albuminoids or scleroproteins:

Insoluble in all neutral solvents, dilute acids or alkalies, e.g., keratin of hair and proteins of bone and cartilage.

2. Conjugated proteins:

Proteins which are made up of amino acids and a non-amino acid/protein substance called the prosthetic group are known as conjugated proteins.

The various types of conjugated proteins are:

(a) Chromoproteins:

Here the non-protein part is a coloured compound in addition to the protein part. Ex. Haemoglobin has heme as the prosthetic group and cytochromes also have heme.

(b) Nucleoproteins:

These proteins are bound to nucleic acids, e.g., chromatin (histones + nucleic acids).

(c) Glycoproteins:

When a small amount of carbohydrate is attached to a protein it is known as glycoproteins, e.g., mucin of saliva. (Note: Glycoproteins have major amounts of protein and some amount of carbohydrates and proteoglycans contain major amounts of carbohydrates and little amount of proteins).

(d) Phosphoprotein:

Phosphoric acid is present with the protein. Ex. Milk casein and egg yolk (vitellin).

(e) Lipoproteins:

Proteins in combination with lipids, e.g., LDL, HDL.

(f) Metalloproteins:

They contain metal ion in addition to the amino acids, e.g., hemoglobin (iron), ceruloplasmin (copper).

3. Derived proteins:

They are the proteins of low molecular weight produced from large molecular weight proteins by the action of heat, enzymes or chemical agents.

A. Primary derivatives

(a) Proteins:

Derived in the early stage of protein hydrolysis by dilute acids, enzymes or alkalis. Examples - Fibrin from fibrinogen.

(b) Metaproteins:

Derived in the later stage of protein hydrolysis by slightly stronger acids and alkalis. Examples - Acid and alkali metaproteins.

(c) Coagulated:

They are denatured proteins formed by the action of heat. X-rays, ultraviolet rays etc. Cooked proteins, coagulated albumins.

B. Secondary derivatives

(a) Proteoses:

Formed by the action of pepsin or trypsin. Precipitated by saturated solution of ammonium sulphate, incoagulable by heat. Examples - Albumose from albumin, globulose from globulin.

(b) Peptones:

Further stage of cleavage than the proteoses. Soluble in water, incoagulable by heat and not precipitated by saturated ammonium sulphate solutions.

(c) Peptides:

Compounds containing two or more amino acids. They may be di-, tri-, and tetrapeptides. Examples - Glycyl-alanine, leucyl-glutamic acid.

2.5.3 Dietary source of Proteins

Every cell of your body contains protein, which is needed to build and maintain muscles, bones, skin and other tissues. For optimum health, women need 46 grams of protein a day, while men require 56 grams, according to the Centers for Disease Control and Prevention.

Proteins from animal foods are "complete," which means it provides all the essential amino acids. "Incomplete" proteins lack one or more essential amino acids and usually come from plant foods.

Some sources of dietary protein include:

a. lean meat, poultry and fish

b. eggs

c. dairy products like milk, yoghurt and cheese

d. seeds and nuts

e. beans and legumes (such as lentils and chickpeas)

f. soy products like tofu

g. some grain and cereal-based products are also sources of protein, but are generally not as high in protein as meat and meat alternative products.

Nutritional value of protein

The nutritional value of a protein is measured by the quantity of essential amino acids that it provides.

Different foods contain different amounts of amino acids. Generally:

Animal products (such as chicken, beef or fish) contain all of the essential amino acids.

Soy products, quinoa and the seed of a leafy green called Amaranth (consumed in Asia and the Mediterranean) also contain all of the essential amino acids. However, plant proteins usually lack at least one amino acid.

People following a strict vegetarian or vegan diet need to choose a variety of protein sources from a combination of plant foods throughout the day to get an adequate mix of amino acids. For example, a meal containing cereals and legumes, such as baked beans on toast, provides all the essential amino acids found in a typical meat dish.

2.5.4 Role of Proteins

I. **Protein is required for the growth and maintenance of tissues** - the body's proteins are in a constant state of turnover. Under normal circumstances, the body breaks down the same amount of protein that it uses to build and repair tissues. Other times, it breaks down more protein than it can create, thus increasing body's needs.

II. **Causes biochemical reactions** - Enzymes are proteins that aid the thousands of biochemical reactions that take place within and outside of the cells.

III. **Acts as a messenger** - Some proteins are hormones, which are chemical messengers that aid communication between your cells, tissues and organs.

IV. **Provides structure** - Some proteins are fibrous and provide cells and tissues with stiffness and rigidity. These proteins include keratin, collagen and elastin, which help form the connective framework of certain structures in your body.

V. **Maintains proper pH** - Protein plays a vital role in regulating the concentrations of acids and bases in your blood and other bodily fluids.

VI. **Balances fluids** - Proteins regulate body processes to maintain fluid balance. Albumin and globulin are proteins in your blood that help maintain your body's fluid balance by attracting and retaining water.

VII. **Boosters immune health** - Proteins form antibodies to protect your body from foreign invaders, such as disease-causing bacteria and viruses.

VIII. **Transports and stored nutrients**-Transport proteins carry substances throughout bloodstream - into cells, out of cells or within cells. The substances transported by these proteins include nutrients like vitamins or minerals, blood sugar, cholesterol and oxygen.

IX. **Provides energy** - Proteins can supply your body with energy. Protein contains four calories per gram, the same amount of energy that carbs provide. Fats supply the most energy, about 9 calories per gram.

2.6 Vitamins

Vitamins are organic compounds that are needed in small quantities to sustain life. Most vitamins need to come from food. This is because the human body either does not produce enough of them, or it does not produce any at all. Each organism

has different vitamin requirements. For example, humans need to consume vitamin C, or ascorbic acid, but dogs do not. Dogs can produce, or synthesize, enough vitamin C for their own needs, but humans cannot. Different vitamins have different roles, and they are needed in different quantities.

2.6.1 What are vitamins?

A vitamin is one of a group of organic substances that is present in minute amounts in natural foodstuffs. Vitamins are essential to normal metabolism. Thus, a vitamin is both:

- ✓ an organic compound, which means it contains carbon
- ✓ an essential nutrient that body cannot produce enough of and which it needs to get from food

2.6.2 Classification

Vitamins may be classified as either fat-soluble or water-soluble.

2.6.2.1 Fat Soluble Vitamins

Fat-soluble vitamins are stored in the fatty tissues of the body and the liver. Vitamins A, D, E, and K are fat-soluble. These are easier to store than water-soluble vitamins, and they can stay in the body as reserves for days, and sometimes months.

Fat-soluble vitamins are absorbed through the intestinal tract with the help of fats, or lipids.

2.6.2.2 Water Soluble Vitamins

Water-soluble vitamins do not stay in the body for long. The body cannot store them, and they are soon excreted in urine. Because of this, water-soluble vitamins need to be replaced more often than fat-soluble ones.

Vitamin C and all the B vitamins are water soluble.

2.6.3 Types and dietary source

Vitamin A

Chemical names: Retinol, retinal, and four carotenoids, including beta carotene.

- ✓ It is fat soluble.

Good sources include: Liver, cod liver oil, carrots, broccoli, sweet potato, butter, kale, spinach, pumpkin, collard greens, some cheeses, egg, apricot, cantaloupe melon, and milk.

Vitamin B1

Chemical name: Thiamine.

✓ It is water soluble.

Good sources include: yeast, pork, cereal grains, sunflower seeds, brown rice, whole-grain rye, asparagus, kale, cauliflower, potatoes, oranges, liver, and eggs.

Vitamin B2

Chemical name: Riboflavin

✓ It is water soluble

Good sources include: asparagus, bananas, persimmons, okra, chard, cottage cheese, milk, yogurt, meat, eggs, fish, and green beans.

Vitamin B3

Chemical names: Niacin, niacinamide

✓ It is water soluble.

Good sources include: liver, heart, kidney, chicken, beef, fish (tuna, salmon), milk, eggs, avocados, dates, tomatoes, leafy vegetables, broccoli, carrots, sweet potatoes, asparagus, nuts, whole-grains, legumes, mushrooms, and brewer's yeast.

Vitamin B5

Chemical name: Pantothenic acid

✓ It is water soluble.

Good sources include: meats, whole-grains (milling may remove it), broccoli, avocados, royal jelly, and fish ovaries.

Vitamin B6

Chemical names: Pyridoxine, pyridoxamine, pyridoxal

✓ It is water soluble.

Good sources include: meats, bananas, whole-grains, vegetables, and nuts.

When milk is dried, it loses about half of its B6. Freezing and canning can also reduce content.

Vitamin B7

Chemical name: Biotin

✓ it is water soluble.

Good sources include: egg yolk, liver, some vegetables.

Vitamin B9

Chemical names: Folic acid, folinic acid

✓ It is water soluble.

Good sources include: leafy vegetables, legumes, liver, baker's yeast, some fortified grain products, and sunflower seeds. Several fruits have moderate amounts, as does beer.

Vitamin B12

Chemical names: Cyanocobalamin, hydroxocobalamin, methylcobalamin

✓ It is water soluble.

Good sources include: fish, shellfish, meat, poultry, eggs, milk and dairy products, some fortified cereals and soy products, as well as fortified nutritional yeast.

Vitamin C

Chemical name: Ascorbic acid

✓ It is water soluble.

Good sources include: fruit and vegetables. The Kakadu plum and the camu camu fruit have the highest vitamin C contents of all foods. Liver also has high levels. Cooking destroys vitamin C.

Vitamin D

Chemical names: Ergocalciferol, cholecalciferol.

✓ It is fat soluble.

Good sources: Exposure to ultraviolet B (UVB) through sunlight or other sources causes vitamin D to be produced in the skin. Also found in fatty fish, eggs, beef liver, and mushrooms.

Vitamin E

Chemical names: Tocopherols, tocotrienols

✓ It is fat soluble.

Good sources include: Kiwi fruit, almonds, avocado, eggs, milk, nuts, leafy green vegetables, unheated vegetable oils, wheat germ, and whole-grains.

Vitamin K

Chemical names: Phylloquinone, menaquinones

✓ It is fat soluble.

Good sources include: leafy green vegetables, avocado, kiwi fruit. Parsley contains a lot of vitamin K.

2.6.4 Importance of vitamins

Vitamins allow body to grow and develop. They also play important roles in bodily functions such as metabolism, immunity and digestion.

1. Vit. A needed for vision, healthy skin and mucous membranes, bone and tooth growth, immune system health.
2. Vit. B1 needed for energy metabolism; important to nerve function.
3. Vit. B2 needed for energy metabolism; important for normal vision and skin health
4. Vit. B3 needed for energy metabolism; important for nervous system, digestive system, and skin health.
5. Vit. B12 needed for making new cells; important to nerve function.
6. Vit. C needed for protein metabolism; important for immune system health; aids in iron absorption.
7. Vit. D needed for proper absorption of calcium; stored in bones.
8. Vit. E antioxidant; protects cell walls.
9. Vit. K needed for proper blood clotting.

2.7 Minerals

Minerals are inorganic substances required by the body in small amounts for a variety of functions. These include the formation of bones and teeth; as essential constituents of body fluids and tissues; as components of enzyme systems and for normal nerve function.

Some minerals are needed in larger amounts than others, e.g. calcium, phosphorus, magnesium, sodium, potassium and chloride. Others are required in smaller quantities and are sometimes called trace minerals, e.g. iron, zinc, iodine, fluoride, selenium and copper. Despite being required in smaller amounts, trace minerals are no less important than other minerals.

2.7.1 Iron and its biological functions

Iron in food exists as two types, heme and non-heme. Animal foods such as meat, seafood and poultry provide both types and are better absorbed by the body. Non-heme iron is found in plant foods, such as spinach and beans, grains that are enriched, like rice and bread, and some fortified breakfast cereals.

Iron is a mineral, and its main purpose is to carry oxygen in the hemoglobin of red blood cells throughout the body so cells can produce energy. Iron also helps remove carbon dioxide. When the body's iron stores become so low that not enough normal red blood cells can be made to carry oxygen efficiently, a condition known as iron deficiency anemia develops.

Infants need iron for brain development and growth. They store enough iron for the first four to six months of life. A supplement may be recommended by a pediatrician for an infant that is premature or a low-birth weight and breastfed. After six months, their need for iron increases, so the introduction of solid foods when the baby is developmentally ready can help to provide sources of iron.

2.7.2 Calcium and its biological functions

Calcium is perhaps the most essential nutrient when it comes to bone health. Building strong bones is like building a healthy balance in your "calcium bank account." Bones are living tissue and constantly in a state of turnover, making calcium deposits and withdrawals daily. Calcium is a mineral that people need to build and

maintain strong bones and teeth. It is also very important for other physical functions, such as muscle control and blood circulation.

Calcium is not made in the body – it must be absorbed from the foods we eat. To effectively absorb calcium from food, our bodies need Vitamin D.

Calcium, the most abundant mineral in the body, is found in some foods, added to others, available as a dietary supplement, and present in some medicines. Calcium is required for vascular contraction and vasodilation, muscle function, nerve transmission, intracellular signaling and hormonal secretion, though less than 1% of total body calcium is needed to support these critical metabolism. Serum calcium is very tightly regulated and does not fluctuate with changes in dietary intakes; the body uses bone tissue as a reservoir and source of calcium, to maintain constant concentrations of calcium in blood, muscle, and intercellular fluids.

If we do not have enough calcium in our diets to keep our bodies functioning, calcium is removed from where it is stored in our bones. Over time, this causes our bones to grow weaker and may lead to osteoporosis - a disorder in which bones become very fragile.

2.7.3 Phosphorus and its biological functions

Phosphorus is a mineral that makes up 1% of a person's total body weight. It is the second most abundant mineral in the body. It is present in every cell of the body. Most of the phosphorus in the body is found in the bones and teeth.

The main function of phosphorus is in the formation of bones and teeth.

It plays an important role in how the body uses carbohydrates and fats. It is also needed for the body to make protein for the growth, maintenance, and repair of cells and tissues. Phosphorus also helps the body make ATP, a molecule the body uses to store energy. In other words sequentially, it can be written as

- build strong bones and teeth
- filter out waste in your kidneys
- manage how your body stores and uses energy
- grow, maintain, and repair tissue and cells
- produce DNA and RNA - the body's genetic building blocks

- balance and use vitamins such as vitamins Band D, as well as other minerals like iodine, magnesium, and zinc
- assist in muscle contraction
- maintain a regular heartbeat
- facilitate nerve conduction
- reduce muscle pain after exercise

2.7.4 Iodine and its biological functions

Iodine is a trace mineral and a nutrient found naturally in the body and is needed for the cells to convert food into energy. Humans need iodine for normal thyroid function, and for the production of thyroid hormones. An essential mineral, iodine is used by the thyroid gland to make thyroid hormones that control many functions in the body including growth and development. Because your body does not produce iodine, it needs to be supplied in the diet. When iodine intake is poor, the body cannot produce enough thyroid hormones. So, it is needed in the diet to ensure that the thyroid works properly.

Thyroid hormones play an important role in a wide range of bodily functions, including metabolism, bone health, immune response, and development of the central nervous system (CNS).

Iodine helps convert thyroid stimulating hormone (TSH) to triiodothyronine (T3) and thyroxine (T4). This conversion is important for the thyroid to function properly.

2.7.5 Selenium and its biological functions

Selenium is a mineral found in the soil. It naturally appears in water and some foods. Selenium is a trace mineral that is essential to good health but required only in small amounts. While people only need a very small amount, selenium plays a key role in the metabolism. Plant foods are the major dietary sources of selenium in most countries throughout the world. The content of selenium in food depends on the selenium content of the soil where plants are grown or animals are raised.

Good natural food sources of selenium include:

- Nuts, like Brazil nuts and walnuts
- Many fresh and saltwater fish, like tuna, cod, red snapper, and herring

- Beef and poultry
- Grains

Whole foods are the best sources of selenium. The mineral may be destroyed during processing.

Selenium is incorporated into proteins to make selenoproteins, which are important antioxidant enzymes. The antioxidant properties of selenoproteins help prevent cellular damage from free radicals. Free radicals are natural by-products of oxygen metabolism. Other selenoproteins help regulate thyroid function and play a role in the immune system.

Some research suggests that selenium may help with the following:

- Prevent certain cancers
- Protect the body from the poisonous effects of heavy metals and other harmful substances

2.7.6 Zinc and its biological functions

Zinc is a trace element that is necessary for a healthy immune system. A lack of zinc can make a person more susceptible to disease and illness. The best sources of zinc are beans, animal meats, nuts, fish and other seafood, whole grain cereals, and dairy products. Zinc is also added to some breakfast cereals and other fortified foods.

Zinc is vital for a healthy immune system, correctly synthesizing DNA, promoting healthy growth during childhood, and healing wounds. The various functions include

- **Regulating immune function** - the human body needs zinc to activate T lymphocytes (T cells).
  T cells help the body in two ways:
  a) controlling and regulating immune responses
  b) attacking infected or cancerous cells
- **Role in wound healing** - Zinc plays a role in maintaining skin integrity and structure. Patients experiencing chronic wounds or ulcers often have deficient zinc metabolism and lower serum zinc levels. Zinc is often used in skin creams for treating diaper rash or other skin irritations.
- **Decreased risk of age-related chronic disease**- improving zinc status through diet and supplementation may reduce the risk of inflammatory diseases.

Deficiency has been linked to increased inflammation in chronic disease and triggering new inflammatory processes.

- **Preventing age-related macular degeneration (AMD)**- Zinc prevents cellular damage in the retina, which helps in delaying the progression of AMD and vision loss.
- **Related to fertility** - Several studies and trials have linked poor zinc status with low sperm quality. Poor zinc intake may be a risk factor for low quality of sperm and male infertility.

2.8 Summary

I. Carbohydrate classification is predominantly based on chemical structure

II. The most nutritionally significant carbohydrate is glucose

III. Carbohydrates vary in their complexity and are found in a wide range of predominantly plant based foods. The exception being lactose from milk

IV. Unsaturated fats are an important part of a healthy diet. These fats help reduce the risk of heart disease and lower cholesterol levels (among other health benefits) when they replace saturated fats in the diet.

V. Trans fats are the worst type of fat for the heart, blood vessels, and rest of the body because they: Raise bad LDL and lower good HDL

VI. Saturated fat is a type of dietary fat. It is one of the unhealthy fats, along with trans fat. These fats are most often solid at room temperature. Foods like butter, palm and coconut oils, cheese, and red meat have high amounts of saturated fat.

VII. Cholesterol is a type of fat found in food, but also in our blood. Cholesterol has many important functions in the body but having high levels of the wrong type of cholesterol in the blood increases heart disease risk.

VIII. Protein is made up of various amino acids. Protein is an important macronutrient. It is required for structure, function and regulation of the body's cells, tissues and organs.

IX. A vitamin is one of a group of organic substances that is present in minute

amounts in natural foodstuffs and is essential for normal metabolism.

X. The B complex vitamins include thiamin (B1), riboflavin (B2), niacin (B3), pantothenic acid (B5), pyridoxine (B6), biotin (B7), folic acid (B9), and B12. They serve many purposes in your body, including aiding in energy production, making red blood cells, and making new DNA so cells can multiply.

XI. In the context of nutrition, a mineral is a chemical element required as an essential nutrient by organisms to perform functions necessary for life. The five major minerals in the human body are calcium, phosphorus, potassium, sodium, and magnesium.

Questions

1. What are carbohydrates? Classify them.
2. What types of lipid are essential for body?
3. Classify proteins with examples.
4. Discuss dietary source of proteins.
5. What are vitamins? Give example and benefit of fat soluble vitamins.
6. Minerals are important for body - discuss

Unit - 3 ❑ Health

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3.8 Summary

3.1 Objectives

This is the unit covering the aspects of Health under the module food, nutrition and health. It is customary to maintain a healthy life so long a person remains alive. After covering the whole unit the reader will be able to

- Describe the concept of health
- To know the diseases developed due to the deficiency of nutrition, micro and micronutrients
- Explain the cause of disease, their symptom and prevention.
- Describe about life style diseases and
- Social health problems.

3.2 Introduction

We all live in a different environment- ecosystem, social system and economy that effect us physically, mentally and spiritually. Good health means capability to strive in adverse situation. That is, how an individual can cope in unfavorable environment - better than the peers or co-inhabitants. For example.

Good physical health can be seen from better immunity, elasticity of bones, smaller healing period, no lethargy, etc.

Similarly, **good mental health** encircles around coping against peer pressure, anxiety, anger, depression etc. and

Good spiritual health will mean that you have the ability to understand the reason of your existence and live your life creating a balance between ambitions and culture. To be of sound body, mind, and spirit, it's important to pay attention to all aspects of health -your mental, emotional, and spiritual sides, all play a role in your physical welfare, and vice versa.

Altogether, circumstances may vary for every individual and bench marking may not be exactly possible, but anything which will make you happier, successful and more contend will be a trait of Good Health.

3.3. Health

3.3.1 What is a good health?

Good health is actively and purposefully behaving in ways that leave you stronger, better nourished, less stressed, and more comfortable in your body and mind. Good health is more than not being sick. When you are healthy, you enjoy many benefits. Good health possesses the energy and motivation to seek the things you most want without the distractions or stresses of illness. Good health is being hardy and sound in body and mind. If you are in good health you are able to enjoy all the good things in life without guilt or shame because you are satisfied and confident in your ability to moderate your behaviors. Good health is being free of addictions and compulsions.

3.3.2 Definition

Health as officially defined by the World Health Organization (WHO, 1948), is "a state of complete physical, mental, and social well-being, not merely the absence of disease or infirmity". In 1986, the WHO further clarified that health is:

"A resource for everyday life, not the objective of living. Health is a positive concept emphasizing social and personal resources, as well as physical capacities."

Health is a dynamic condition resulting from a body's constant adjustment and adaptation in response to stresses and changes in the environment for maintaining an inner equilibrium called homeostasis. This means that health is a resource to support an individual's function in wider society. A healthful lifestyle provides the means to lead a full life.

3.3.3 Concept of Health

Health is difficult to define but easier to understand. To many of us it may mean absence of disease or infirmity and to many it may mean sound body and sound mind and sound function of the body. To an anatomist Healthy body means it should confirm to normal anatomical structures. To a physiologist Health means normal body functions. To a biochemist it means normal biochemical levels / values. To a pathologist it means normal cellular make up. To a geneticist it means correct existence of genetic potential. Similarly to a clinician it means no abnormality in structure and function of the body. When a clinician fails to detect anything abnormal by his clinical wisdom and laboratory tests he labels a person no abnormality detected (NAD). To a psychiatrist it means well adjusted and a balanced personality.

Physical health

It means adequate body weight, height and circumference as per age and sex with acceptable level of vision, hearing, locomotion or movements, acceptable levels of pulse rate, blood pressure, respiratory rate, chest circumference, head circumference, waist hip ratio.

It means the body structure and functions confirming to laid down standards within the range of normal development and functions of all the systems.

Mental health

The positive dimension of mental health is stressed in WHO's definition of health as contained in its constitution. Mental health is defined ‘‘as a state of well being in which the individual realized his or her own abilities, can cope with normal stresses of life, can work productively and fruitfully and is able to make a contribution to his or her community"

A mentally normal person has the ability to mix up with others, he/she makes friendship, behaves in a balanced manner, keeps himself tidy and observes adequate personal hygiene, well oriented to time, place and person and environments and he is unduly not suspicious of others. He is cheerful and happy and enjoys life with a purpose and he thinks positively and has normal development and contributes fully and is useful and productive to society and nation.

Social well being

It is the third dimension of health. It means ability of a person to adjust with others in his social life, at home, at work place and with people. Men interact with men and they inter-relate and inter depend on each other and pay their effective role in accordance with a situation. Essentially social wellbeing includes inter-relation and interaction of human beings. Social wellbeing is a composite function of income level, literacy, occupation and working conditions, marital harmony, institution of a family, social group and has good cultural and behavioral patterns of the society. Social wellbeing can be measured on scale by taking in to consideration of indicators like income, literacy and occupation (as discussed under socio economic status of family).

Environment

The environment is considered to be the most important determinant and input of health. Health is influenced in the man made environment or natural environment too. It included items like housing, transport, industries and communication. Availability, accessibility, affordability and acceptability of health services are considered an important determinant finput to health.

Health indicator

It is somewhat easier to defined health for an individual. But to define “community health” it is somewhat more difficult. “Community health” parameters are different from health parameters of an individual.

“Community health” can be measured through indicators of economics, (gross national product gross national income and per capita income), life expectancy, under five mortality, infant mortality, maternal mortality, literacy level, composite index of human development, etc.

A community is healthy when it enjoys sound health where disease and death rate is acceptably low, it is not threatened with bad environments and its economy

is sound and the health resources are available, practices are sound and based on scientific evidences. Its literacy levels are high and demographically it has balanced sex ratio and people live long, quality of life is good and human development index is high.

A village is said to be healthy if it has: safe sources of improved water supply, safe method of waste water disposal, paved streets, disposal of garbage refuse and animal excreta by manure pits, people use sanitary latrines, female literacy is high, girls enrolment is universal, deliveries are conducted by trained persons, birth rate and death rate are within acceptable limits, immunization coverage is high and housing condition is good.

Health is a fundamental human right. The attainment of highest possible level of health is the most important worldwide social goal.

3.4 Major nutritional deficiency diseases

This is a disease caused by insufficient dietary intake of macro and micro nutrients. Persistent malnutrition may lead to elevated morbidity and mortality rates. Important functional disturbances may occur as a result of single or multiple nutrient deficiencies. Diseases include, but are not limited to, Protein Energy Malnutrition, Scurvy, Rickets, Beri Beri, Hypocalcemia, Osteomalacia, Vitamin K Deficiency, Pellagra, Cheilosis, Menkes Disease, Xerophthalmia. Examples thus include impaired cognitive function, impaired function of the immune system, and impaired function of skeletal muscle.

The most significant nutrition-related disease is chronic undernutrition, which outbreaks more than 925 million people worldwide. Undernutrition is a condition in which there is insufficient food to meet energy needs; its main characteristics include weight loss, failure to thrive, and wasting of body fat and muscle. Low birth weight in infants, inadequate growth and development in children, diminished mental function, and increased susceptibility to disease are among the many consequences of chronic undernutrition which affects those living in poverty in both industrialized and developing countries.

3.4.1 Protein Energy Malnutrition (PEM)

Malnutrition is the impaired function that results from a prolonged deficiency of total energy or specific nutrients such as carbohydrate, protein, fat, vitamins, or minerals. This condition can result from fasting and anorexia nervosa; persistent

vomiting (as in bulimia nervosa) or inability to swallow; Impaired digestion and intestinal malabsorption; or chronic illnesses that result in loss of appetite (e.g., cancer, AIDS). Malnutrition can also result from limited food avarlabilrtv, unwise food choices, or overzealous use of dietary supplements.

Chronic undernutrition manifests primarily as protein-energy malnutrition (PEM), which is the most common form of malnutrition worldwide. Also known as protein-calorie malnutrition, PEM is a continuum in which people—all too often children—consume too little protein, energy, or both. The term protein-energy malnutrition (PEM) applies to a group of related disorders that include marasmus, kwashiorkor (see the images below), and intermediate states of marasmus-kwashiorkor.

3.4.1.1 Kwashiorkor

Kwashiorkor, a Ghanaian word meaning the disease that the first child gets when the new child comes, is typically seen when a child is weaned from high-protein breast milk onto a carbohydrate food source with insufficient protein. Childrern with this disease, which is characterized by a swollen belly (Fig. 3.1) due to edema (fluid retention), are weak, grow poorly, and are more susceptible to infectious diseases, which may result in fatal diarrhea. Other symptoms of kwashiorkor include apathy, hair discoloration, and dry, peeling skin with sores that fail to heal. Weight loss may be disguised because of the presence of edema, enlarged fatty liver, and intestinal parasites; moreover, there may be little wasting of muscle and body fat.

3.4.1.1.1 Causes

Kwashiorkor is the result of severe malnutrition or lack of protein and, usually, calories as well. A child may sometimes have a continued cereal- or grain-based diet that may have some calories but lacks sufficient nutrients and protein. Proteins are responsible for maintaining fluid balance in the body. Without proteins, fluid shifts to areas it should not be.

This is what happens when someone has kwashiorkor.

3.4.1.1.2 Symptoms

In short the symptoms are

1. Changes in skin pigment
2. Decreased muscle mass

3. Diarrhea
4. Failure to gain weight and grow
5. Fatigue
6. Hair changes (change in color or texture)
7. Increased and more severe infections due to damaged immune system
8. Irritability
9. Large belly that sticks out (protrudes)
10. Lethargy or apathy
11. Loss of muscle mass
12. Rash (dermatitis)
13. Shock (late stage)
14. Swelling (edema)

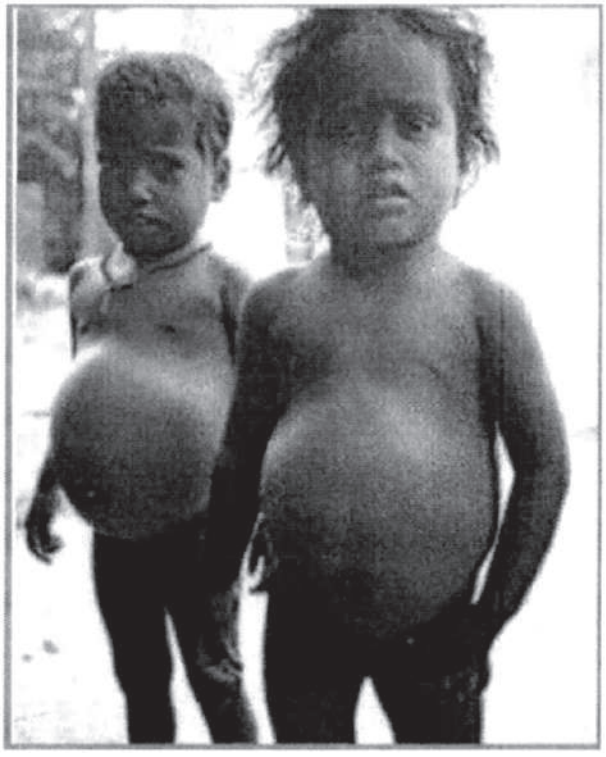

Fig. 3.1 Children *having Kwashiorkor*

3.4.1.1.3 Treatments

While kwashiorkor is a condition related to malnutrition, merely feeding a child or adult will not correct all the deficiencies and effects ofthe condition.

If a child has gone without sufficient protein and nutrients for a long time, eating again can be a shock to their system if reintroducing food is not done carefully.

Many children with kwashiorkor will also develop lactose intolerance. As a result, they may need to avoid milk products or take enzymes so their bodies can handle milk.

Doctors treating the condition will first give carbohydrates, then add in proteins, vitamins, and minerals. The reintroduction of food may take a week or more to accomplish safely.

Additionally, if a child's condition is so advanced that they are in shock with low blood pressure and a high heart rate, they may need to take medication to support their blood pressure.

3.4.1.1.4 Prevention

To prevent kwashiorkor, it should be made sure that the diet has enough carbohydrates, fat (at least 10% of total calories), and protein (12% of total calories).

Lack of protein in the diet is the cause of kwashiorkor. Every cell in the body contains protein. Protein in diet is needed for the body to repair cells and make new cells. A healthy human body regenerates cells in this way constantly. Protein is also especially important for growth during childhood and pregnancy. If the body lacks protein, growth and normal body functions will begin to shut down, and kwashiorkor may develop.

Prevention of kwashiorkor can only be assured through a change in the living conditions of the child and the community. This must include the education of mothers and other caregivers, provision of a balanced and varied diet, improved hygiene, clean water, as well as prevention and treatment of repeated infections such as gastro- enteritis, measles, HIV and TB.

3.4.1.2 Marasmus

An infant with marasmus is extremely underweight and has lost most or all subcutaneous fat. The body has a "skin and bones" appearance, (Fig. 3.2) and the child is profoundly weak and highly susceptible to infections. The cause is a diet

very low in calories from all sources (including protein), often from early weaning to a bottled formula prepared with unsafe water and diluted because of poverty. Poor hygiene and continued depletion lead to a vicious cycle of gastroenteritis and deterioration of the lining of the gastrointestinal tract, which interferes with absorption of nutrients from the little food available and further reduces resistance to infection. If untreated, marasmus may result in death due to starvation or heart failure.

Kwashiorkor and marasmus can also occur in hospitalized patients receiving intravenous glucose for an extended time, as when recovering from surgery, or in those with illnesses causing loss of appetite or malabsorption of nutrients.

3.4.1.2.1 Causes

Causes of marasmus include:

1. not having enough nutrition or having too little food
2. consuming the wrong nutrients or too much of one and not enough of another
3. having a health condition that makes it difficult to absorb or process nutrients correctly

Older adults who live alone and find it difficult to prepare food and care for themselves may be at risk. Sometimes marasmus can affect an older adult, who has not eaten healthfully over a period of some months or years,

While consuming the wrong nutrients and having a health condition can contribute to marasmus, each of these alone would probably not be enough to cause it, as long as calories are available.

3.4.1.2.2 Symptoms

The symptoms of marasmus are

1. Severe growth retardation
2. Loss of subcutaneous fat
3. Severe muscle wasting
4. The child looks appallingly thin and limbs appear as skin and bone
5. Shriveled body
6. Wrinkled skin
7. Bony prominence

8. Associated vitamin deficiencies
9. Failure to thrive
10. Irritability, fretfulness and apathy
11. Frequent watery diarrhoea and acid stools
12. Mostly hungry but some are anoretic
13. Dehydration
14. Temperature is subnormal
15. Muscles are weak
16. Oedema and fatty infiltration are absent

Fig. 3.2 Children *having marasmus*

3.4.1.2.3 Treatment

Marasmus is a life-threatening medical emergency. When symptoms appear, the person needs treatment straight away.

Rapid weight loss, infections, and sudden changes in behavior or appetite could be signs of an underlying problem, such as an eating disorder or a chronic health condition. A medical professional will need to prepare a specific eating plan for anyone with a diagnosis of marasmus. It is critical for a person with marasmus to receive a diet treatment that is rich in nutrients, carbohydrates, and calories. They will need more calories than is usual for their age. However, their body may find it hard to tolerate or digest food after losing so much fat and body tissue.

One solution is for doctors to provide food in small amounts and possibly through tubes to the veins and stomach. These tubes allow for food and fluid to be delivered quickly and directly to the body. A full recovery can still take months, even with the right treatment plan. An individual may also need treatment for the complications, such as infections and dehydration.

If marasmus results from an eating disorder, a person is also likely to need mental health treatment and support.

3.4.1.2.4 Prevention

The best way to prevent marasmus is to have an adequate intake of calories and protein, preferably from a healthful, well-balanced diet.

Foods rich in protein, such as skimmed milk, fish, eggs, and nuts are ideal for energy and growth, though any protein and calorie-rich food can be used to prevent marasmus, depending on what is available.

Vegetables and fruits are essential for providing other nutrients and minerals and for preventing vitamin deficiencies. People can also take supplements, but they may be less effective than foods in delivering nutrients.

A person who has recovered or is recovering from marasmus should take care to avoid complications, including dehydration and diarrhea.

Integrated child Development service (ICDS) was launched by Govt. of India (GOI) in 1975 for all round development of children (0–1 yr). Pregnant and lactating mothers are also included.

3.4.2 Vitamin A deficiency disorders (VAO)

Vitamin A deficiency can result from inadequate intake, fat malabsorption, or liver disorders. Deficiency impairs immunity and hematopoiesis and causes rashes and typical ocular effects (eg, xerophthalmia, night blindness).

Vitamin A is found in many foods (Fig. 3.3) like:

- leafy green vegetables
- orange vegetables (carrots, sweet potatoes, pumpkin)
- eggs, and
- cantaloupes.

Failing to intake adequate vitamin A from the food source may lead to deficiency disorder.

3.4.2.1 Role of Vitamin A and their deficiency result

Vitamin A plays an important role in vision. To see the full spectrum of light, the eye needs to produce certain pigments for the retina to work properly. Vitamin A deficiency stops the production of these pigments, leading to night blindness. The eye also needs vitamin A to nourish other parts of the eye, including the cornea. Without enough vitamin A, the eyes cannot produce enough moisture to keep them properly lubricated.

Vitamin A deficiency is the leading cause of preventable blindness in children worldwide. An estimated 250,000 to 500,000 children become blind every year because of vitamin A deficiency. Half of these children die within a year of losing their sight.

In pregnant women, vitamin A deficiency causes night blindness and may contribute to maternal mortality. Vitamin A deficiency also harms the immune system (the body's ability to fight disease). This increases the chance of death from malaria, measles and diarrhea.

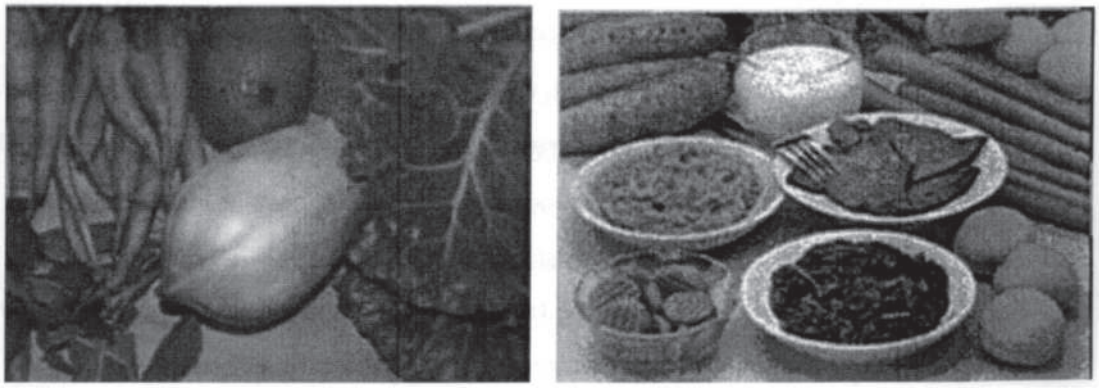

Fig. 3.3 *Vitamin A available foods*

3.4.2.2 Symptoms

1. Dry skin- Vitamin A is important for the creation and repair of skin cells. It also helps fight inflammation due to certain skin issues.

2. Dry eyes- Dry eyes, or the inability to produce tears, are one of the first signs of vitamin A deficiency.
3. Night blindness- severe vitamin A deficiency can lead to night blindness. Women with night blindness given vitamin A in the form of food or supplements improved the condition.
4. Infertility and trouble conceiving- Vitamin A is necessary for reproduction in both men and women, as well as proper development in babies. One of the reasons having trouble getting pregnant, is a lack of vitamin A. Vitamin A deficiency can lead to infertility in both men and women.
5. Delayed growth- Children who do not get enough vitamin A may experience stunted growth. This is because vitamin A is necessary for the proper development of the human body.
6. Throat and chest infections- Frequent infections, especially in the throat or chest, may be a sign of vitamin A deficiency. Vitamin A supplements may help respiratory tract infections
7. Poor wound healing - Wounds that do not heal well after injury or surgery may be linked to low vitamin A levels. This is because vitamin A promotes the creation of collagen, an important component of healthy skin.
8. Acne and breakouts- Since vitamin A promotes skin development and fights inflammation, it may help prevent or treat acne. Low vitamin A levels linked the to the presence of acne.

3.4.2.3 Treatments

Vitamin A deficiency can be treated with vitamin A supplements. The amount of supplements depends upon the age of the child. Vitamin A supplements can reverse night blindness. It can also help the eyes become lubricated again. But vision loss caused by scarring from corneal ulcers cannot be reversed.

There are organizations working to stop vitamin A deficiency in developing nations. They promote prevention through a balanced diet and taking vitamin supplements.

3.4.2.4 Prevention

1. Distribution of massive dose capsules (with polio vaccine)
2. Food fortification (to improve nutrition by enriching commonly-used food products with important vitamins and minerals) Cooking Oil, Wheat Flour

3. Horticulture and agriculture — Green leafy vegetables
   — Orange colored fruits & vegetables (Fig. 3.3)
4. Nutrition & health education - Radio, TV, School etc
5. Mothers will need advice about
   - Breast feeding
   - Weaning in general
   - How to prepare them, e.g. giving fried egg to the child
   - Liver, egg, cheese, butter, fish liver oil etc are good sources of vitamin A
6. Immunization
   - Measles
7. Avoid traditional healers-Herbs, Tooth paste etc

The National Prophylaxis Programme Against Nutritional Blindness (NPPANB) was launched in India in 1970.

3.4.3 Iron deficiency disorders

Iron is a mineral needed by our bodies. Iron is a part of some cells and does many things in our bodies. For example, iron (as part of the protein hemoglobin) carries oxygen from our lungs throughout our bodies. Having too little hemoglobin is called anemia. Iron also helps our muscles store and use oxygen.

Iron is a part of many enzymes and is used in many cell functions, Enzymes help our bodies digest foods and also help with many other important reactions that occur within our bodies. When our bodies don't have enough iron, many parts of our bodies are affected.

Iron deficiency is a condition resulting from too little iron in the body. Iron deficiency is the most common nutritional deficiency and the leading cause of anemia.

The terms anemia, iron deficiency, and iron deficiency anemia often are used interchangeably but equivalent. Iron deficiency ranges from depleted iron stores without functional or health impairment to iron deficiency with anemia, which affects the functioning of several organ systems.

3.4.3.1 Causes

Iron deficiency has many causes. These causes fall into two main categories:

A. Increased iron needs

Many common conditions can cause people to need additional iron :

- Because of their rapid growth, infants and toddlers need more iron than older children. Sometimes it can be hard for them to get enough iron from their normal diet.
- Women who are pregnant have higher iron needs. To get enough, most women must take an iron supplement as recommended by their healthcare provider.
- When people lose blood, they also lose iron. They need extra iron to replace what they have lost. Increased blood loss can occur with heavy menstrual periods, frequent blood donation, as well as with some stomach and intestinal conditions (food sensitivity, hookworms.)

B. Decreased iron intake or absorption (not enough iron taken into the body)

The amount of iron absorbed from the diet depends on many factors:

- Iron from meat, poultry, and fish (i.e., heme iron) is absorbed two to three times more efficiently than iron from plants (i.e., non-heme iron).
- The amount of iron absorbed from plant foods (non-heme iron) depends on the other types of foods eaten at the same meal.
- Foods containing heme iron (meat, poultry, and fish) enhance iron absorption from foods that contain non-heme iron (e.g., fortified cereals, some beans, and spinach).
- Foods containing vitamin C also enhance non-heme iron absorption when eaten at the same meal.

3.4.3.2 Symptoms

Too little iron can impair body functions, but most physical signs and symptoms do not show up unless iron deficiency anemia occurs. Someone with early stages of iron deficiency may have no signs or symptoms. This is why it is important to screen for too little iron among high risk groups.

Signs of iron deficiency anemia include

1. Feeling tired and weak
2. Decreased work and school performance
3. Slow cognitive and social development during childhood
4. Difficulty maintaining body temperature

5. Decreased immune function, which increases susceptibility to infection
6. Glossitis (an inflamed tongue)

3.4.3.3 Treatments

1. Treatment will depend on factors such as the age, health, and cause of iron deficiency.
2. Needs Iron supplements and further check up of hemoglobin and hematocrit test.
3. If the iron deficiency is due to a diet low in iron, it needs to eat more ron-rich foods.
4. If iron deficiency can have causes not related to diet, then recommendations will be specific according to the needs.

3.4.3.4 Prevention

1. Generally eating healthful diet that includes good sources of iron is the primary measure of prevention.
2. A healthful diet includes fruits, vegetables, whole grains, fat free or nonfat milk and milk products, lean meats, fish, dry beans, eggs, nuts, and is low in saturated fat, trans fats, cholesterol, salt, and added sugars.
3. In addition to a healthful diet that includes good sources of iron, it is better to eat also foods that help the body to absorb iron better. For example, eating a fruit or vegetable that is a good source of vitamin C with a food or meal that contains non- heme iron. Vitamin C helps the body absorb the non-heme iron foods vailable to eat, especially when the food containing non-heme iron and the vitamin-C rich food are eaten at the same meal.

3.4.3.5 Government programmes

The Govt. of India has implemented through the Primary Health Centers and its subcenters, aims at decreasing the prevalence and incidence of anemia in women of reproductive age. It focuses on three vital strategies: promotion of regular consumption of foods rich in iron, provisions of iron and folate supplements in the form of tablets to the high risk groups, and identification and treatment of severely anemic cases. The program solicits the support of various departments in implementing the dietary modification and supplementation measures.

1. Pregnant women are recommended to have one big tablet per day for 100 days after the first trimester of pregnancy; a similar dose applies to lactating women and IUD acceptors.
2. Preschool children (ages 1-5 years) are recommended to take one small tablet per day for 100 days every year.
3. Adult tablets contain 100 mg iron and 500 mg folic acid, while pediatric tablets contain 20 mg iron and 100 mg folic acid.
4. For treatment of severe anemia, women in the reproductive age group are recommended to take three adult tablets per day for a minimum of 100 days.
5. Drinking tea is discouraged, as it may inhibit the absorption of iron in the stomach.

   The National Nutritional Anemia Control Program (NNACP) has been implemented in 1999 to improve coverage, quality and efficiency.

3.4.4 Iodine deficiency disorders (IDO)

Both insufficient and excessive iodine intake can result in thyroid disease. The term "iodine deficiency disorders" refers to all of the consequences of iodine deficiency, which depend on its severity and the age of the affected subject. When severe iodine deficiency occurs during pregnancy, it is associated with fetal hypothyroidism, mental impairment, and increased neonatal and infant mortality. In adults, iodine-induced hypothyroidism is rare, while the most common manifestation is goiter that progresses to nodular goiter and eventually to thyroid autonomy and hyperthyroidism.

Iodine is an essential component of thyroxine (T4) and triiodothyronine (T3), and it must be provided in the diet. Inadequate iodine intake leads to inadequate thyroid hormone production, and all the consequences of iodine deficiency stem from the associated hypothyroidism.

It is a global public health problem and, in combating it, emphasis should be placed on diagnosis and correction at the level of the community rather than the individual.

3.4.4.1 Causes

Iodine is an element that is needed for the production of thyroid hormone. The body does not make iodine, so it is an essential part of one's diet. Iodine is found in various foods (Table-3). If there is not enough iodine in the body, the body cannot make enough thyroid hormone. Thus, iodine deficiency can lead to enlargement of the thyroid (goiter), (Fig. 3.4) hypothyroidism and to intellectual disabilities in infants and children whose mothers were iodine deficient during pregnancy. The Iodine deficiency results in

1. Goiter
2. Physical and mental retardation
3. Subnormal intelligence
4. Neuromuscular weakness
5. Spasticity
6. Hypothyroidism
7. Dwarfism
8. Cretinism
9. Deaf-mutism and defect in vision
10. Frequent abortions, still births or intrauterine death in pregnant mothers

TABLE 3. COMMON SOURCES OF DIETARY IODINE
Cheese
Cows milk
Eggs
Frozen Yogurt
Iodine-containing multivitamins
Ice Cream
Iodized table salt
Saltwater fish
Seaweed (including kelp, dulce, nori)
Shellfish
Soy milk
Soy sauce
Yogurt

Fig. 3.4 *Enlargement of thyroid (Goiter)*

3.4.4.2 Symptoms

An iodine deficiency can cause uncomfortable and even severe symptoms. They include swelling in the neck, pregnancy-related issues, weight gain and learning difficulties.

Its symptoms are very similar to those of hypothyroidism, or low thyroid hormones. Since iodine is used to make thyroid hormones, an iodine deficiency means body can't make enough of them, leading to hypothyroidism.

Symptoms of an iodine deficiency

1. Swelling in the neck- Swelling in the front of the neck is the most common symptom of an iodine deficiency. This is called a goiter and occurs when the thyroid gland grows too big.
2. Unexpected weight gain- Unexpected weight gain is another sign of an iodine deficiency. It may occur if the body does not have enough iodine to make thyroid hormones. Low iodine levels may slow metabolism and encourage food to be stored as fat, rather than be burned as energy. This may lead to weight gain.
3. Fatigue and weakness- Low iodine levels may leave you feeling tired, sluggish and weak. This is because body needs the mineral to make energy.
4. Hair loss- An iodine deficiency may prevent hair follicles from regenerating. Fortunately, getting sufficient iodine can help correct hair loss that occurs due to an iodine deficiency.

5. Dry, flaky skin- An iodine deficiency may prevent hair follicles from regenerating. Fortunately, getting sufficient iodine can help correct hair loss that occurs due to an iodine deficiency.
6. Feeling colder than usual- Feeling cold is a common symptom of an iodine deficiency. Iodine helps generate body heat, so low levels of it may leave you feeling colder than usual.
7. Changes in heart rate- An iodine deficiency may slow heart rate, which may leave one feeling weak, fatigued, dizzy and at risk of fainting.
8. Trouble learning and remembering - An iodine deficiency at any age may cause you to struggle to learn and remember things. One possible reason for this might be an underdeveloped brain.
9. Problems during pregnancy-Getting enough iodine is especially important for pregnant and breastfeeding women, as they have higher needs. An iodine deficiency may cause severe side effects, especially for the baby, such as stunted growth and brain development.
10. Heavy or irregular periods -Sorne women with an iodine deficiency may experience heavy or irregular periods. This is because low thyroid hormone levels may interfere with hormones that are involved in regulating the menstrual cycle.

3.4.4.3 Treatments

There are no tests to confirm if there is enough iodine in the body. When iodine deficiency is seen in an entire population, it is best managed by ensuring that common foods that people eat contain sufficient levels of iodine. Since even mild deficiency during pregnancy can have effects on a pregnancy and the developing baby. All women who are planning pregnancy, pregnant or breastfeeding should take a multivitamin containing 150 µg iodine per day.

Iodine deficiency is best corrected by a healthy diet. If your diet alone is not supplying enough iodine, you may want to consider adding an iodine supplement.

People who may not be getting enough iodine through food often include:

- ✓ Vegetarians
- ✓ Vegans
- ✓ Pregnant women

3.4.4.4 Prevention

As with many diseases, it is better to prevent the problem rather than have to treat it. Over the last 80 years, worldwide efforts have been made to eliminate iodine deficiency. Elimination of iodine deficiency has been a major goal of the Iodine Global Network, UNICEF, and the World Health Organization. Iodized salt has been the mainstay of the prevention of iodine deficiency worldwide. In regions where iodized salt is not widely available, or where pregnant women are known to have inadequate iodine intakes, use of a daily iodine-containing supplement may be recommended for pregnant and breastfeeding women. Injections of iodized oil are occasionally used in severely iodine deficient regions ofthe world where widespread iodized salt use is not possible.

Recommendations for iodine intake during pregnancy and breast feeding – Recommended iodine intakes are higher for women who are pregnant or breastfeeding than for other adults. The Recommended Dietary Allowance (RDA) is 220 μg iodine per day for pregnant women and 290 μg iodine per day for breastfeeding women.

The average daily salt intake in India is 10 g. Consumption levels are within the 5-15 g/day range for children and adults. As per Government of India recommendations, the level of salt iodization (quantity of iodine added to salt) should provide a minimum of 150 mcg of iodine per day at the consumption level. From the average daily intake of 10 g iodine fortified salt, the estimated availability of iodine would be 150 mcg, of which about 30% is lost during cooking. The remaining 105 mcg is ingested and from this about 70% is absorbed by the body.

3.4.4.5 Government Programmes

In 1962, the government of India implemented the National Goitre Control Programme, now called the National Iodine Deficiency Disorders Control Programme (NIDDCP). In 1982, the government made a policy decision to iodate all edible salt in India by 1992. During 1994-1995, India's private sector produced 34 lakh metric tons of iodated salt per year. The government expects iodated salt production to increase to 50 lakh metric tons in the near future. Iodated salt is transported on the railways under a priority category that is second only to defense. In 19 states and 6 union territories, the sale of noniodated salt has been completely banned. The remaining state governments have been urged to ban the sale of non iodated salt and to include iodated salt under the public distribution system.

Each State Health Directorate has been advised to set up an IDD Control Cell. District health officers tn all endemic states have test kits to conduct on-the-spot qualitative testing to ensure quality control of iodated salt at the consumption level.

NIDDCP provides IDD surveys, health education, and publicity campaigns. Its information, education, and campaign activities include video films, posters, and radio/TV spots.

3.5 Lifestyle related disease

A disease associated with the way a person or group of people lives. Lifestyle diseases include atherosclerosis, hypertension, heart disease and stroke; obesity and type 2 diabetes; and diseases associated with smoking and alcohol and drug abuse. Regular physical activity and good food habit helps prevent obesity, heart disease, hypertension, diabetes, colon cancer, and premature mortality.

The main factors contributing to lifestyle diseases include bad food habits, physical inactivity, wrong body posture, and disturbed biological clock.

3.5.1 Hypertension

Hypertension is the medical term for high blood pressure. This means that the blood applies too much force against the walls of the blood vessels. Normal blood pressure is 120 over 80 mm of mercury (mmHg), but hypertension is higher than 130 over 80 mmHg. Acute causes of high blood pressure include stress, but it can happen on its own, or it can result from an underlying condition, such as kidney disease. Unmanaged hypertension can lead to a heart attack, stroke, and other problems.

3.5.1.1 Causes

The cause of hypertension is often not known.

Around 1 in every 20 cases of hypertension is the effect of an underlying condition or medication. Chronic kidney disease (CKD) is a common cause of high blood pressure because the kidneys do not filter out fluid. This fluid excess leads to hypertension.

3.5.1.2 Risk factors

A number of risk factors increase the chances of having hypertension.

1. **Age:** Hypertension is more common in people aged over 60 years. With age, blood pressure can increase steadily as the arteries become stiffer and narrower due to plaque build-up.
2. **Ethnicity:** Some ethnic groups are more prone to hypertension.
3. **Size and weight:** Being overweight or obese is a key risk factor.
4. **Alcohol and tobacco use:** Consuming large amounts of alcohol regularly can increase a person's blood pressure, as can smoking tobacco.
5. **Sex:** The lifetime risk is the same for males and females, but men are more prone to hypertension at a younger age. The prevalence tends to be higher in older women.
6. **Existing health conditions:** Cardiovascular disease, diabetes, chronic kidney disease, and high cholesterol levels can lead to hypertension, especially as people get older.

Other contributing factors include:

1. physical inactivity
2. a salt-rich diet associated with processed and fatty foods
3. low potassium in the diet
4. alcohol and tobacco use
5. certain diseases and medications

A family history of high blood pressure and poorly managed stress can also contribute.

3.5.1.3 Prevention (Dietary modifications)

A variety of dietary modifications are beneficial in the treatment of hypertension, including reduction of sodium intake, moderation of alcohol, weight loss in the overweight or obese, and a diet rich in fruits, vegetables, legumes, and low-fat dairy products and low in snacks, sweets, meat, and saturated fat. Individual dietary factors may also reduce blood pressure (BP).

By starting a few new food habits, including counting calories and watching portion sizes, one may be able to lower blood pressure and reduce the medications that need to control high blood pressure. How it can be managed?

A. By tracking the food intake

Some people are not aware of how many calories they eat and drink each day. They may underestimate how much they eat and wonder why they can't lose weight.

Writing down the foods you eat, including the portion sizes, can let you see the truth about your food intake. You can then start cutting back — reducing calories and portions — to lose weight and manage your blood pressure.

Alcohol can increase blood pressure, as well.

B. By avoiding salt (Sodium)

A high-sodium diet increases blood pressure in many people. In fact, the less sodium you eat, the better blood pressure control you might have. To lower the sodium in the diet, following suggestions can be made:

1. Use a food diary to keep track of the salt in the foods to eat.
2. To aim for less than 2,300 milligrams (about 1 teaspoon of salt) each day.
3. To read the nutritional facts label on every food package.
4. To select foods those have 5% or less of the "Daily Value" of sodium.
5. To avoid foods those have 20% or more ''Daily Value'' of sodium.
6. To avoid canned foods, processed foods, lunch meats, and fast foods
7. To use salt-free seasonings.

C. To know what to eat

Potassium, magnesium, and fiber, on the other hand, may help control blood pressure. Fruits and vegetables are high in potassium, magnesium, and fiber, and they're low in sodium. Stick to whole fruits and veggies. Juice is less helpful, because the fiber is removed. Also, nuts, seeds, legumes, lean meats, and poultry are good sources of magnesium.

Thus Dietary Approaches to Stop Hypertension (DASH) is an eating plan rich in fruits, vegetables, whole grains, fish, poultry, nuts, legumes, and low-fat dairy. These foods are high in key nutrients such as potassium, magnesium, calcium, fiber, and protein.

3.5.1.4 Prevention (Lifestyle modifications)

1. Prevention through lifestyle modifications is the universal "vaccine" against hypertension.

2. Weight Reduction - by maintaining normal body weight
   (Body Mass Index) BMI: 18.5 - 24.9
   BP reduction: (5-20 mmHg/l0 kg loss)
3. DASH Eating Plan- Dietary Approaches to Stop Hypertension
   Fruits, Vegetables, Low-fat dairy
   Reduce saturated and total fat
   (8-14 mmHg BP reduction).
4. Dietary Sodium Reduction -2.4 grams Sodium or 6 grams Sodium Chloride
   (2-8 mmHg BP reduction)
5. Physical Activity - Regular aerobic physical activity
   (4-9 mmHg BP reduction)
6. Smoking Cessation - Any independent chronic effect of smoking on BP is small. Smoking cessation does not decrease BP, but total cardiovascular risk is increased by smoking. Therefore hypertensives who smoke should be counselled on smoking cessation.

So, A healthy lifestyle must be adopted to combat these diseases with a proper balanced diet, physical activity and by giving due respect to biological clock. Kids spending too much time slouched in front of the TV or PCs, should be encourage to find a physical sport or activity they enjoy. Fun exercises should be encouraged into family outings. A pizza-and-video evening should be replaced for a hike and picnic. Kids who do participate in sport, especially at a high competitive level, can find the pressure to succeed very stressful. To decrease the ailments caused by occupational postures, one should avoid long sitting hours and should take frequent breaks for stretching or for other works involving physical movements.

3.5.2 Diabetes mellitus

Diabetes mellitus refers to a group of diseases that affect how the body uses blood sugar (glucose). Glucose is vital for the health because it's an important source of energy for the cells that make up muscles and tissues. It's also a brain's main source of fuel.

The underlying cause of diabetes varies by type. But, no matter what type of diabetes you have, it can lead to excess sugar in your blood. Too much sugar in your blood can lead to serious health problems.

Chronic diabetes conditions include type 1 diabetes and type 2 diabetes. Potentially reversible diabetes conditions include prediabetes - when the blood sugar levels are higher than normal, but not high enough to be classified as diabetes- and gestational diabetes, which occurs during pregnancy but may resolve after the baby, is delivered.

3.5.2.1 Type 1 Diabetes

Type 1 diabetes is also called insulin-dependent diabetes. It used to be called juvenile-onset diabetes, because it often begins in childhood.

Type 1 diabetes is an autoimmune condition. It's caused by the body attacking its own pancreas with antibodies. In people with type 1 diabetes, the damaged pancreas doesn't make insulin.

This type of diabetes may be caused by a genetic predisposition. It could also be the result of faulty beta cells in the pancreas that normally produce insulin.

A number of medical risks are associated with type 1 diabetes. Many of them stem from damage to the tiny blood vessels in your eyes (called diabetic retinopathy), nerves (diabetic neuropathy), and kidneys (diabetic nephropathy). Even more serious is the increased risk of heart disease and stroke.

3.5.2.2 Type 2 Diabetes

Type 2 diabetes used to be called adult-onset diabetes, but with the epidemic of obese and overweight kids, more teenagers are now developing type 2 diabetes. Type 2 diabetes was also called non-insulin-dependent diabetes.

Type 2 diabetes is often a milder form of diabetes than type 1. Nevertheless, type 2 diabetes can still cause major health complications, particularly in the smallest blood vessels in the body that nourish the kidneys, nerves, and eyes. Type 2 diabetes also increases your risk of heart disease and stroke.

With Type 2 diabetes, the pancreas usually produces some insulin. But either the amount produced is not enough for the body's needs, or the body's cells are resistant to it. Insulin resistance, or lack of sensitivity to insulin, happens primarily in fat, liver, and muscle cells.

3.5.2.3 Causes of diabetes

Diabetes causes vary depending on the genetic makeup, family history, ethnicity, health and environmental factors. There is no common diabetes cause that fits every

type of diabetes.The reason there is no defined diabetes cause is because the causes of diabetes vary depending on the individual and the type.

For instance; the causes of type 1 diabetes vary considerably from the causes of gestational diabetes.

Similarly, the causes of type 2 diabetes are distinct from the causes of type 1 diabetes.

3.5.2.3.1 Type 1 diabetes causes

Type 1 diabetes is caused by the immune system destroying the cells in the pancreas that make insulin. This causes diabetes by leaving the body without enough insulin to function normally.

This is called an autoimmune reaction, or autoimmune cause, because the body is attacking itself.

There is no specific diabetes causes, but the following triggers may be involved:

1. Viral or bacterial infection
2. Chemical toxins within food
3. Unidentified component causing autoimmune reaction

Underlying genetic disposition may also be a type 1 diabetes cause.

3.5.2.3.2 Type 2 diabetes causes

Type 2 diabetes causes are usually multifactorial - more than one diabetes cause is involved. Often, the most overwhelming factor is a family history of type 2 diabetes.

This is the most likely type 2 diabetes cause.

There are a variety of risk factors for type 2 diabetes, any or all of which increase the chances of developing the condition.

These include:

1. Obesity
2. Living a sedentary lifestyle
3. Increasing age
4. Bad diet

3.5.2.4 Prevention (Dietary modifications)

The general dietary advice to reduce risk of type 2 diabetes is to decrease intakes of fat and carbohydrate (refined sugar) and increase intake of dietary fiber.

Healthy - eating plan helps diabetic people to control diabetes. The plan helps to control blood sugar (glucose), manage weight and control heart disease risk factors, such as high blood pressure and high blood fats.

Extra calories and fat intake creates undesirable rise in blood glucose which should be avoided.

Healthy food choices and tracking eating habits help keeping blood glucose level; in a safe range.

A diabetes diet is based on eating three meals a day at regular times. This helps better use of the insulin that the body produces or gets through a medication.

Recommended foods are choosing healthy carbohydrates, fiber-rich foods, fish and "good" fats.

Healthy carbohydrates, such as: Fruits, Vegetables, Whole grains, Legumes, such as beans and peas, and Low-fat dairy products, such as milk and cheese.

Better to avoid less healthy carbohydrates such as foods or dnnks with added as, sugars and sodium.

Foods high in fiber include: vegetables, fruits, nuts, leguurnes. Such as beans and peas, and whole grains.

Heart -healthy fish such as salmon, mackerel, tuna and sardines are rich in omega-3 fatty acids, to be eaten at least twice a week.

"Good" fats available in foods like Avocados, Nuts, Canola, olive and pea nut oils. As all fats are high in calories excess of it should be avoided.

3.5.2.5 Prevention (lifestyle modifications)

Lifestyle changes are often advised for people at higher risk of diabetes and those who are newly diagnosed with type 2, to help manage their diabetes.

The recommended lifestyle interventions include:

1. Taking two and a half hours each week of moderate intensity physical activity or one hour and 15 minutes of high intensity exercise.

2. Losing weight gradually to achieve a healthy body mass index.
3. Replacing refined carbohydrates with wholegrain foods and increase intake of vegetables and other foods high in dietary fiber.
4. Reducing the amount of saturated fat in the diet.

Physical activity

Taking either 2½ hours of moderate intensity physical activity or 1¼ hours of intense exercise.

Moderate intensity physical activity includes:

a) Brisk walking

b) Cycling on relatively flat terrain

c) Water aerobics

d) Hiking

e) Rollerblading

f) Using a manual lawnmower

Vigorous physical activity may include:

a) Jogging

b) Swimming lengths

c) Cycling either rapidly or over steep terrain

d) Football

e) Gymnastics

f) Skipping

World Diabetes Day is the global awarness campaign focussing on diabetes mellitus and is held on 14th November each year.

3.5.3 Obesity

Obesity is a complex disorder involving an excessive amount of body fat. Obesity isn't just a cosmetic concern. It increases the risk of diseases and health problems, such as heart disease, diabetes and high blood pressure.

Being extremely obese means you are especially likely to have health problems related to your weight.

A Body Mass Index (BMI) between 25 and 29.9 indicates that a person is carrying excess weight. A BMI of 30 or over suggests that a person may have obesity.

The good news is that even modest weight loss can improve or prevent the health problems associated with obesity. Dietary changes, increased physical activity and behavior changes can help to lose weight. Prescription medications and weight-loss surgery are additional options for treating obesity.

3.5.3.1 Causes

Although there are genetic, behavioral and hormonal influences on body weight, obesity occurs when you take in more calories than you burn through exercise and normal daily activities. Body stores these excess calories as fat.

In general, the principal causes of obesity are:

1) Consuming too many calories – When a person consumes more calories than they use as energy, their body will store the extra calories as fat. This can lead to excess weight and obesity. Also, some types of foods are more likely to lead to weight gain, especially those that are high in fats and sugars.

Foods that tend to increase the risk of weight gain include:

- ✓ fast foods,
- ✓ fried foods, such as french fries,
- ✓ fatty and processed meats
- ✓ many dairy products
- ✓ foods with added sugar, such as baked goods, ready-made breakfast cereals, and cookies
- ✓ foods containing hidden sugars, such as ketchup and many other canned and packaged food items
- ✓ sweetened juices, sodas, and alcoholic drinks
- ✓ processed, high-carb foods, such as bread and bagels

2) Leading a sedentary lifestyle - Many people lead a much more sedentary lifestyle than their parents and grandparents did.

Examples of sedentary habits include:

- ✓ working in an office rather than doing manual labour
- ✓ playing games on a computer instead of doing physical activities outside
- ✓ going to places by car instead of walking or cycling

The less a person moves around, the fewer calories they burn.

Also, physical activity affects how a person's hormones work, and hormones have an impact on how the body processes food.

3) **Not Sleeping enough -** missing sleep increases the risk of gaining weight and developing obesity. Sleep deprivation may lead to obesity because it can lead to hormonal changes that increase the appetite.

4) **Endocrine disruptors -** Scientists believe there is a link between high consumption of fructose and obesity and metabolic syndrome. Authorities have raised concerns about the use of high-fructose corn syrup to sweeten drinks and other food products.

   Increased fructose intake may be an important predictor of metabolic risk in young people.

5) **Obesity gene -** A faulty gene called the fat-mass and obesity-associated gene (FTO) is responsible for some cases of obesity.

3.5.3.2 Prevention

Whether you're at risk of becoming obese, currently overweight or at a healthy weight, you can take steps to prevent unhealthy weight gain and related health problems. Not surprisingly, the steps to prevent weight gain are the same as the steps to lose weight: daily exercise, a healthy diet, and a long-term commitment to watch what you eat and drink.

3.5.3.2.1 Dietary modifications

1. Follow a healthy eating plan. Focus on low-calorie, nutrient-dense foods, such as fruits, vegetables and whole grains. Avoid saturated fat and limit sweets and alcohol.

Eat three regular meals a day with limited snacking. You can still enjoy small amounts of high-fat, high-calorie foods as an infrequent treat. Just be sure to choose foods that promote a healthy weight and good health most of the time.

3.5.3.2.2 Lifestyle modifications

A balanced diet and gradually becoming more physically active as part of any obesity treatment plan is usually recommended. These lifestyle modifications can also help prevent obesity if overweight or otherwise at risk. Achieving and maintaining a healthy weight through diet and exercise can also help manage or reverse some of the serious conditions associated with obesity, such as hypertension and type 2 diabetes.

Following lifestyle should be maintained to prevent obesity:

- **Exercise regularly** - You need to get 150 to 300 minutes of moderate-intensity activity a week to prevent weight gain. Moderately intense physical activities include fast walking and swimming.
- **Know and avoid the food traps that cause you to eat** - Identify situations that trigger out-of-control eating. Try keeping a journal and write down what you eat, how much you eat, when you eat, how you're feeling and how hungry you are. After a while, you should see patterns emerge. You can plan ahead and develop strategies for handling these types of situations and stay in control of your eating behaviors.
- **Monitor your weight regularly** - People who weigh themselves at least once a week are more successful in keeping off excess pounds. Monitoring your weight can tell you whether your efforts are working and can help you detect small weight gains before they become big problems.
- **Be consistent**. Sticking to your healthy-weight plan during the week, on the weekends, and amidst vacation and holidays as much as possible increases your chances of long-term success.

World Obesity Day is observed globally on 11 october every year in the view of promoting practical solution to end the obesity arises.

3.6 Social health problems

Social problems are the general factors that affect and damage society. A social problem is normally a term used to describe problems with a particular area or group of people in the world. Social problems often involve problems that affect the real world. It also affects how people react to certain situations. Examples can include:

- Anti social behavior

- Poverty
- Drug abuse
- Transgenderism
- Prostitution
- Alcohol abuse
- Economic Deprivation
- Unemployment
- Sexual abuse
  - Rape
  - Early pregnancy
  - Female genital mutilation
- Animal abuse

3.6.1 Smoking

While smoking may appear to be a socially acceptable trend on college campuses, it still brings with it serious health problems. The consequences can be affecting social life in several ways. The biggest affect is secondhand smoke. The people around a person smoking are involuntarily inhaling smoke and toxins from cigarettes.

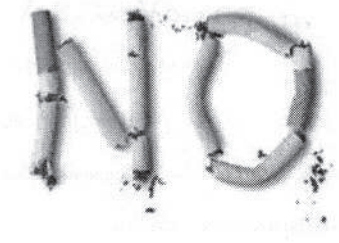

Fig. 3.5 *'No' to smoking*

Secondhand smoke is toxic and has been proven to lead to many health problems.

Some of these health problems are:

- ✓ Greater risk of respiratory infections such as bronchitis or pneumonia
- ✓ More frequent and/or severe asthma attacks

- ✓ Heart disease
- ✓ Risk of heart attack
- ✓ Increased risk of smoke
- ✓ Lung cancer

3.6.1.1 Causes of smoking

Most smokers started when they were teens. Those who have friends and/or parents who smoke are more likely to start smoking than those who don't. Some teens say that they "just wanted to try it," or they thought it was "cool" to smoke.

The tobacco industry's ads, price breaks, and other promotions for its products are a big influence in our society. The tobacco industry spends billions of dollars each year to create and market ads that show smoking as exciting, glamorous, and safe. Tobacco use is also shown in video games, online, and on TV. And movies showing smokers are another big influence. Studies show that young people who see smoking in movies are more likely to start smoking.

A newer influence on tobacco use is the e-cigarette and other high-tech, fashionable electronic "vaping" devices. Often seen as harmless, and easier to get and use than traditional tobacco products, these devices are a great way for new users to learn how to inhale and become addicted to nicotine, which can prepare them for smoking.

3.6.1.2 Diseases caused by smoking

The diseases caused by smoking harm almost every organ in the body, cause many diseases, and reduces the health of smokers in general. It is responsible for a heap of other awful diseases, contributing to the tobacco epidemic we face today.

1. Going blind- . Smoking increases your risk of age-related macular degeneration, the leading cause of blindness in adults over the age of 65.
2. Type 2 diabetes- Smoking contributes to type 2 diabetes and increases the risk of complications from the disease- including poor blood flow to legs and feet.
3. Erectile dysfunction- Male sexual function is affected when you smoke. Tobacco causes narrowing of blood vessels all over your body, including those that supply blood to the penis.
4. Ectopic pregnancy - Ectopic pregnancy is a life-threatening reproductive complication in women that is more likely in smokers. It occurs when a fertilized

egg implants somewhere other than the uterus. The egg can't survive and it puts mom's life at serious risk.

5. Colorectal cancer- Colorectal cancer, which forms in your intestines (colon or rectum), is the second leading cause of cancer.
6. Rheumatoid arthritis - Rheumatoid arthritis is a chronic inflammatory disease more common in women that affects the joints in your hands and feet. It causes painful swelling that can eventually result in bone loss and joint deformity. Smoking is one of the causes, and is also associated with developing the disease at an earlier age.
7. Cleft lip and cleft palate - These birth defects, commonly called orofacial clefts, occur when a baby's lip or mouth doesn't develop properly during pregnancy. Women who smoke during pregnancy are more likely to have babies with orofacial clefts.
8. Fertility issues- It causes reduced fertility in women and can contribute to other problems during pregnancy.

3.6.1.3 Treatments

Although smoking is an addiction, people can quit smoking. The steps in quitting, each of which requires special attention and efforts by the smoker, are getting ready to quit, quitting, and staying quit.

A number of techniques are available to assist people who want to quit, including nicotine replacement therapy (NRT), behavioral modification, self-help literature, and prescription medications.

In nicotine replacement therapy, which is the cornerstone of most smoking cessation programs, another source of nicotine is substituted while the cigarettes are stopped. (The idea of nicotine replacement therapy is to eliminate both the smoking habit - although the addiction remains - and the symptoms of withdrawal. Then, the replacement nicotine is gradually stopped.)

Currently, three forms of nicotine replacement therapy are available over the counter: nicotine patches, nicotine gum, and nicotine lozenges, while two forms are available by prescription, an inhaler and a nasal spray.

Varenicline (Champix) is a prescription drug that can help adults quit smoking. It is believed to act on the same receptors (the sites where nicotine acts to produce

its effects) in the brain as nicotine, resulting in activation (stimulation) of these receptors and blocking the ability of nicotine to attach to these receptors.

3.6.1.4 Prevention

Quitting smoking improves health in smokers of all ages and a good way to prevent smoking. Different ways to quit smoking have been studied. The following are the most common methods used to help smokers quit:

1. Counseling
2. Drug treatment
3. Smoking reduction
4. There are new and different types of tobacco and nicotine products.
5. New ways to help smokers quit are being studied in clinical trials.

Counseling

People who have even a short counseling session with a health care professional are more likely to quit smoking. The doctor or other health care professional may take the following steps to help you quit:

- ✓ Ask about your smoking habits at every visit.
- ✓ Advise you to stop smoking.
- ✓ Ask you how willing you are to quit.
- ✓ Help you plan to quit smoking by:
  - setting a date to quit smoking;
  - giving you self-help materials;
  - recommending drug treatment.
- ✓ Plan follow-up visits with you.

Say "NO" (Fig. 3.5) **to teen smoking -** You might feel as if your teen doesn't hear a word you say, but say it anyway. Tell your teen that smoking isn't allowed. Your disapproval will have more impact than you think. Teens whose parents set the firmest smoking restrictions tend to smoke less than do teens whose parents don't set smoking limits. The same goes for teens who feel close to their parents.

Do the maths - Smoking is expensive. Help your teen calculate the weekly, monthly or yearly cost of smoking a pack a day. You might compare the cost of smoking with that of electronic devices, clothes or other teen essentials.

Get involved - Take an active stance against teen smoking. Participate in local and school-sponsored smoking prevention campaigns. Support efforts to make public places smoke-free and increase taxes on tobacco products. Your actions can help reduce the odds that your teen will become a smoker.

No Smoking Day is observed every year on the second weak of March to encourage people to quit smoking.

3.6.2 Alcoholism

Alcoholism, now known as Alcohol Use Disorder (AUD), is a condition in which a person has a desire or physical need to consume alcohol, even though it has a negative impact on their life.

A person with this condition does not know when or how to stop drinking. They spend a lot of time thinking about alcohol, and they cannot control how much they consume, even if it is causing serious problems at home, work, and financially.

Alcohol abuse can be used to talk about excessive or inappropriate consumption of alcohol, but not necessarily dependence.

Moderate alcohol consumption does not generally cause any psychological or physical harm. However, if who enjoy social drinking increase their consumption or regularly consume more than is recommended, AUD may eventually develop.

3.6.2.1 Causes

Alcohol dependence can take from a few years to several decades to develop.

For some people who are particularly vulnerable, it can happen within months.

Over time, regular alcohol consumption can disrupt the balance of:

- gamma-aminobutyric acid (GABA) in the brain
- glutamate

GABA controls impulsiveness and glutamate stimulates the nervous system.

Dopamine levels in the brain rise after consuming alcohol. Dopamine levels may make he drinking experience more gratifying.

Over the long- or medium-term, excessive drinking can significantly alter the levels of these brain chemicals. This causes the body to crave alcohol in order to feel good and avoid feeling bad.

3.6.2.2 Possible risk factors

Some risk factors may also be linked to excessive drinking.

1) **Genes:** Some specific genetic factors may make some people more likely to develop an addiction to alcohol and other substances. There may be a family history.
2) **The age of the first alcoholic drink:** A study has suggested that people who start drinking alcohol before the age of 15 years may be more likely to have problems with alcohol later in life.
3) **Easy access:** There appears to be a correlation between easy access to alcohol - such as cheap prices - and alcohol abuse and alcohol-related deaths. One study registered a significant drop in alcohol-related deaths after one state raised alcohol taxes. The effect was found to be nearly two to four times that of other prevention strategies, such as school programs or media campaigns.
4) **Stress:** Some stress hormones are linked to alcohol abuse. If stress and anxiety levels are high, a person may consume alcohol in an attempt to blank out the upheaval.
5) **Peer drinking:** People whose friends drink regularly or excessively are more likely to drink too much. This can eventually lead to alcohol-related problems.
6) **Low self-esteem:** Those with low self-esteem who have alcohol readily available are more likely to consume too much.
7) **Depression:** People with depression may deliberately or unwittingly use alcohol as a means of self-treatment. On the other hand, consuming too much alcohol may increase the risk of depression, rather than reducing it.
8) **Media and advertising:** In some countries, alcohol is portrayed as a glamorous, worldly, and cool activity. Alcohol advertising and media coverage of it may increase the risk by conveying the message that excessive drinking is acceptable.
9) **How the body processes (metabolizes) alcohol:** People who need comparatively more alcohol to achieve an effect have a higher risk of eventually developing health problems related to alcohol.

3.6.2.3 Treatments

When you're struggling with an alcohol use disorder (AUD), you may feel as though there's no end in sight, but you don't have to suffer alone. There are many treatment options available today that will help you recover from alcoholism and get back to living a healthy and fulfilling life.

The following are recognized treatment options for alcoholism:

a) **Do-it-yourself:** Some people with an alcohol problem manage to reduce their drinking or abstain without seeking professional help.

b) **Counseling:** A qualified counselor can help the person share their problems and then devise a plan to tackle the drinking. Cognitive behavioral therapy (CBT) is commonly used to treat alcohol dependency.

c) **Residential programs:** These can offer expert professional help, individual or group therapy, support groups, training, family involvement, activity therapy, and a host of strategies for treating alcohol abuse. Being physically away from access to temptation is helpful for some people.

d) **Drug that provokes a severe reaction to alcohol:** Antabuse (disulfiram) causes a severe reaction when somebody drinks alcohol, including nausea, flushing, vomiting, and headaches. It is a deterrent, but it will not treat the compulsion to drink or solve the problem in the long term.

e) **Drugs for cravings:** Naltrexone (ReVia) may help reduce the urge to have a drink. Acamprosate (Campral) may help with cravings.

f) **Detoxification:** Detoxification is the initial step in treating alcoholism, and it can also be the most difficult. Within the first few days after you quit drinking, you may experience extremely uncomfortable withdrawal symptoms. Because of this, the alcohol detox stage should only be completed under professional medical care.

   Treatment specialists will also be able to provide you with medication to help ease the pain. This allows you to focus on getting better. After detox, you will be able to move forward with other forms of treatment and therapy.

g) **Abstinence:** Some people complete detox successfully, but they start drinking again either soon after or some time later. Access to counseling, medical help, support groups, and family support can all help the individual avoid alcohol as time goes on.

3.6.2.4 Prevention

Alcoholism can impact anyone irrespective of gender, personal beliefs, ethnicity, age, or body type. However, the following groups have been identified as being at a higher risk hence the focus of prevention interventions. The groups are people of low esteem, professionals, and people with mental disorder and families with a drinking history.

If you are already into drinking, preventing the urge and ultimately stopping can be a challenge. However, there are strategies and routines on how to prevent alcoholism you can adapt to cut back and eventually stop drinking altogether.

Recognize triggers

Internal and external triggers such as places, people, times of day, positive emotions, and negative emotions like frustration can leave you craving a drink. Recognizing these triggers is one way how to avoid alcohol. Move away from certain places, change the company, or switch to something else.

Don't keep alcohol at home

Access to alcohol increases the likelihood of drinking. Fully-stocked liquor cabinets and half-drunk bottles of wine can set off your drinking triggers. If there is no social purpose, keep alcoholic drinks out of your house. In fact, you can substitute with other drinks such as tea, water, and lemonade.

Engage in other activities

Instead of spending time in bars, look for other joints where there are non-drinking activities. You can take a walk, watch a movie or pick up a sport as a strategy on how to avoid drinking alcohol.

Cut down on the number of drinks

Stopping alcoholism is a gradual process that takes time. You should start by cutting down on the drinks you take per day or week. Work on a practical prevention schedule and have an accountability partner. The best way on how to avoid alcohol poisoning is by taking water in between your drinks.

Build a Social Support Network

Surrounding yourself with people of positive influence and those that build your confidence is hugely important as it can help you avoid excessive drinking. They can help you make life changes necessary for long-term sobriety.

Alcohol Anonymous (AA) India is a Fellowship of men and women who help each other with their common problem with alcoholism.

3.6.3 Drug dependence

Drug dependence occurs when you need one or more drugs to function. To distinguish between dependence and abuse, it was felt that the mild or early phase of inappropriate drug use was considered abuse that led to dependence. People viewed dependence as a more severe problem than abuse.

Drug dependence is a state in which individual uses the drug so frequently & consistently that it appears difficult for the person to get along without using the drug - occurs when a person relies on a drug for normal physiological functioning. If the person abstains from taking the drug, he or she will experience withdrawal symptoms such as sweating, vomiting or diarrhea. Abstaining from drug use can also trigger problems in mental functioning such as lack of focus, depression or anxiety.

3.6.3.1 Drug dependence vs. drug addiction

People sometimes use the terms “addiction” and “dependence” interchangeably. Dependence is not the same as addiction.

Addiction

Addiction can occur without being dependent on drugs. Addiction may involve:

a) using drugs despite the consequences

b) being unable to stop using drugs

c) neglecting social and work obligations because of drug use

Dependence

It’s possible to be dependent on drugs without being addicted. Dependence can be a bodily response to a substance. This often occurs if you rely on medications to control a chronic medical condition. These conditions may include:

a) high blood pressure

b) diabetes

c) glaucoma

Dependence may involve:

a) some or all the symptoms of addiction

b) development of a high tolerance for the substance as your body adapts to the drug, leading to a desire for larger or more frequent doses

c) physical symptoms of withdrawal when you attempt to stop using the drug

3.6.3.2 Causes

While specific incentives differ from person to person, generally speaking, people start using drugs to escape or mask pain.

In some individuals, the onset of drug use can be from untreated psychiatric issues including anxiety and depression. The rush of pleasure from using drugs can provide temporary solace from suffering, which can stem from many mental health or other issues including the following:

a. Trauma or abuse

b. Mental illness

c. Low self-esteem

d. Poverty

e. Relationship problems

f. Loss of a loved one

g. Stress

h. Chronic pain or medical conditions

But whatever their reason for starting, once addiction sets in, the disease usually spirals more and more out oftheir control.

3.6.3.3 Treatments

Although there's no cure for drug addiction, treatment options explained below can help you overcome an addiction and stay drug-free. Your treatment depends on the drug used and any related medical or mental health disorders you may have. Long-term follow-up is important to prevent relapse.

Chemical dependence treatment programs- Treatment programs usually offer:

a. Individual, group or family therapy sessions

b. A focus on understanding the nature of addiction, becoming drug-free and preventing relapse

c. Levels of care and settings that vary depending on your needs, such as outpatient, residential and inpatient programs

Detoxification

The goal of detoxification, also called "detox" or withdrawal therapy, is to enable you to stop taking the addicting drug as quickly and safely as possible. For some people, it may be safe to undergo withdrawal therapy on an outpatient basis. Others may need admission to a hospital or a residential treatment center.

Behavior therapy

As part of a drug treatment program, behavior therapy - a form of psychotherapy - can be done by a psychologist or psychiatrist, or you may receive counseling from a licensed alcohol and drug counselor. Therapy and counseling may be done with an individual, a family or a group.

3.6.3.4 Prevention

Drug prevention programs are designed to provide the education and support necessary to diminish drug dependency in communities, schools and the workplace. Drug abuse prevention has become an important first step in informing specific individuals about the dangers of addiction prevention techniques and where to find recovery help if it should be deemed necessary.

Drug abuse prevention begins with education, spreading the word regarding the dangers of drugs to oneself and to the community. These programs are just the beginning. The information provided is most effective when it is followed up with continued support. Drug prevention programs seek to involve the family, community or workplace in the prevention process. To be effective, communities need to sustain the progress. This often requires continued leadership and financial support.

3.6.4 Acquired Immunodeficiency Syndrome (AIDS)

AIDS stands for "acquired immunodeficiency syndrome. Acquired immunodeficiency syndrome (AIDS) is a chronic, potentially life-threatening condition

caused by the human immunodeficiency virus (HIV). By damaging one's immune system, HIV interferes with the body's ability to fight the organisms that causes the disease.

HIV is a sexually transmitted infection (STI). It usually spreads from person to person through contact with infected sexual secretions or blood. It can also be spread from mother to child during pregnancy, childbirth or breast feeding.

3.6.4.1 How HIV affects?

The human immunodeficiency virus (HIV) causes AIDS and represents the most advanced stage of HIV infection. HIV spreads through contact with infected blood or fluids such as sexual secretions. Over time, the virus attacks the immune system, focusing on special cells called "C/D 4 cells" which are important in protecting the body from infections and cancers, and the number of these cells starts to fall. Eventually, the C/D cells fall to a critical level and/or the immune system weakens so much that it can no longer fight off certain types of infections and cancers. AIDS is an advanced stage of HIV infection.

HIV is a very small virus that contains ribonucleic acid (RNA) as its genetic material. When HIV infects animal cells, it uses a special enzyme, reverse transcriptase, to turn (transcribe) its RNA into DNA. ("Retroviruses" are viruses that use reverse transcriptase.) When HIV reproduces, it is prone to making small genetic mistakes or mutations, resulting in viruses that vary slightly from each other. This ability to create minor variations allows HIV to evade the body's immunologic defenses, essentially leading to lifelong infection, and has made it difficult to make an effective vaccine. The mutations also allow HIV to become resistant to antiretroviral medications.

3.6.4.2 Causes

People transmit HIV in bodily fluids, including:

a. blood

b. semen

c. vaginal secretions

d. anal fluids

e. breast milk

The main causes of this transfer of fluids are:

1) anal or vaginal intercourse with a person who has HIV while not using a condom or PrEP, a preventive HIV medication for people at high risk of infection

2) sharing equipment for injectable illicit drugs, hormones, and steroids with a person who has HIV

A woman living with HIV who is pregnant or has recently given birth might transfer the disease to her child during pregnancy, childbirth, or breastfeeding.

The risk of HIV transmitting through blood transfusions is extremely low in countries that have effective screening procedures in place for blood donations.

Undetectable = untransmittable

To transmit HIV, these fluids must contain enough of the virus. If a person has 'undetectable' HIV, they will not transmit HIV to another person, even if after a transfer of fluids.

Undetectable HIV is when the amount of HIV in the body is so low that a blood test cannot detect it. People may be able to achieve undetectable levels of HIV by closely following the prescribed course of treatment.

Confirming and regularly monitoring undetectable status using a blood test is important, as this does not mean that the person no longer has HIV. Undetectable HIV relies on the person adhering to their treatment, as well as the effectiveness ofthe treatment itself.

3.6.4.3 Treatment

No cure is currently available for HIV or AIDS.

However, treatments can stop the progression of the condition and allow most people living with HIV the opportunity to live a long and relatively healthy life.

Starting ART (Antiretroviral treatment) early in the progression of the virus is crucial. This improves quality of life, extends life expectancy, and reduces the risk of transmission, according to the WHO's guidelines.

More effective and better-tolerated treatments have evolved that can improve general

health and quality of life by taking as little as one pill per day.

A person living with HIV can reduce their viral load to such a degree that it is no longer detectable in a blood test. Medical professionals refer to this as undetectable = untransmittable (U=U).

Emergency HIV pills, or post-exposure prophylaxis

If an individual believes they have been exposed to the virus within the last 3 days, anti-HIV medications, called post-exposure prophylaxis (PEP), may be able to stop infection. Take PEP as soon as possible after potential contact with the virus.

PEP is a treatment lasting a total of 28 days, and physicians will continue to monitor for HIV after the completion of the treatment.

Complementary or alternative medicine

Although many people who have HIV try complementary, alternative, or herbal options, such as herbal remedies, no evidence confirms them to be effective.

3.6.4.4 Prevention

To prevent contracting HIV, healthcare professionals advise precautions related to the following.

a) **Sex using a condom or PrEP:** Having sex without a condom or other preventive measures, such as PrEP, can drastically increase the risk of transmitting HIV and other sexually transmitted infections (STls).

   Use condoms or PrEP during every sexual act with a person outside of a trusted relationship in which neither partner has HIV.

b) **Drug injection and needle sharing:** Intravenous drug use is a key factor for HIV transmission in developed countries. Sharing needles and other drug equipment can expose users to HIV and other viruses, such as hepatitis C.

   People using a needle to take medications should use a clean, unused, unshared needle.

c) **Body fluid exposure:** A person can limit their potential exposure to HIV by taking precautions to reduce the risk of exposure to contaminated blood.

   Healthcare workers should use gloves, masks, protective eyewear, shields, and gowns in situations where exposure to bodily fluids is a possibility.

Frequently and thoroughly washing the skin immediately after coming into contact with blood or other bodily fluids can reduce the risk of infection. Healthcare works should follow a set of procedures known as universal precautions to prevent transmission.

d) **Pregnancy:** Certain antiretrovirals might harm an unborn fetus during pregnancy.

However, an effective, well-managed treatment plan can prevent mother-to-fetus HIV transmission. Delivery through caesarean section may be necessary.

Women who are pregnant but have HIV might also pass on the virus through their breast milk. However, regularly taking the correct regimen of medications greatly reduces the risk of transmitting the virus.

e) **Education:** Teaching people about known risk factors is vital to equip them with the tools to avoid exposure to HIV.

f) **World Health Day**, designated on 1 December every year since 1988, is dedicated to raising awareness of AIDS pandemic caused by the spread of AID infection.

3.7 Common ailments

It is a physical condition in which there is a disturbance of normal functioning. So the result of something that troubles you is an ailment – a pain or discomfort that just doesn't seem to go away. If you've got a rash or a persistent cough, you can call that an ailment. Some other common, ailments are allergies or chronic headaches. They can be a real pain. Some of the common ailments are

a) Colds and other upper respiratory conditions. Upper respiratory problems, including inflammation, congestion and irritation of the nose, mouth, throat and sinuses.

b) Fatigue

c) Headache

d) Rash

e) Infection

f) Back pain

3.7.1 Cold

The most common cold symptoms include sore or scratchy throat, nasal **congestion** or stuffiness, a runny nose, and a **cough**. Someone may also experience sneezing, **low**-grade **fever**, or **fatigue**. The full life cycle of a cold is usually between 7 and 10 days.

The common cold is a viral infectious disease that infects the upper respiratory system. It is also known as acute viral rhinopharyngitis and acute coryza. It is the most common infectious disease in humans and is mainly caused by coronaviruses or rhinoviruses.

Because there are more than 200 viruses that cause the common cold, the human body can never build up resistance to all of them. This is why colds are so common and often return. According to the CDC (Centers for Disease Control and Prevention), adults get 2-3 colds per year, and children may have up to 12 per year.

The common cold is contagious; it can be spread by air droplets from coughs and sneezes and by touching infected surfaces. It is contagious from 1-2 days before symptoms begin until the symptoms have stopped.

3.7.1.1 Causes

The common cold can be caused by more than 200 different viruses. Around 50 percent of colds are caused by rhinoviruses, other cold-causing viruses include:

1) human parainfluenza virus
2) human metapneumovirus
3) coronaviruses adenovirus
4) human respiratory syncitial virus
5) enteroviruses

When a virus manages to overpower the body's immune system, infection occurs. The first line of defense is mucus, which is produced in the nose and throat by the mucus glands. This mucus traps anything inhaled, such as dust, viruses, and bacteria. Mucus is a slippery fluid that the membranes of the nose, mouth, throat, and vagina produce.

When the mucus is penetrated by the virus, the virus then enters a cell, the virus

takes control and uses the cell's machinery to manufacture more viruses, and these viruses then attack surrounding cells.

3.7.1.2 Treatments

It is important to realize that both antibiotics and antiviral medications are ineffective against most viruses that cause the common cold. A cold normally lasts up to 10 days; however, some symptoms can stay as long as 3 weeks.

Although there is no real way of treating or curing a common cold, the following measures may help ease the symptoms:

a) Drink plenty of fluids and keep well hydrated, being dehydrated when infected with a cold can make symptoms worse.

b) Get plenty of bed rest; it is important to get as much sleep/rest as possible while the immune system is fighting off the virus.

c) Take aspirin, acetaminophen, or ibuprofen to relieve headache or fever. Children under 16 are not suitable for aspirin.

d) Some people find that inhaling steam helps ease the symptoms of nasal congestion.

3.7.1.3 Prevention

As there are so many viruses that can cause a cold, it is difficult to develop a vaccine.

However, there are some precautions that can help avoid catching the common cold. These include:

- Avoid close contact with someone infected with a cold.
- Eat plenty of vitamin-rich fruit and vegetables to help keep the immune system strong.
- When sneezing or coughing, make sure it is done into a tissue. Discard the tissue carefully and wash your hands.
- If you sneeze into your hands, make sure you wash them with soap and water immediately.

- If you have no tissues or a handkerchief, cough into the inside (crook) of your elbow rather than your hands.
- Wash your hands regularly; cold viruses can be transmitted from one person to another by touch. In fact, more germs are passed by shaking hands than by kissing.
- Keep surfaces in your home clean - especially in the kitchen or bathroom.
- Avoid touching your face, especially your nose and mouth.

3.7.2 Cough

A cough is a common reflex action that clears the throat of mucus or foreign irritants. Coughing to clear the throat is typically an infrequent action, although a number of conditions can cause more frequent bouts of coughing. In general, a cough that lasts for less than three weeks is an acute cough. A cough that lasts between 3 and 8 weeks, improving by the end of that period, is a subacute cough. A persistent cough that lasts more than eight weeks is a chronic cough.

Most cough episodes will clear up, or at least significantly improve, within two weeks. If you cough up blood or have a "barking" cough, consultation of doctor is must. Any cough that hasn't improved after a few weeks may be serious, and one should see a doctor.

3.7.2.1 Causes

A cough can be caused by several conditions, both temporary and permanent.

Clearing the throat

A cough is a standard way of clearing the throat. When your airways become clogged with mucus or foreign particles such as smoke or dust, a cough is a reflex reaction that attempts to clear the particles and make breathing easier.

Usually, this type of coughing is relatively infrequent, but coughing will increase with exposure to irritants such as smoke.

Viruses and bacteria

The most common cause of a cough is a respiratory tract infection, such as a cold or flu. Respiratory tract infections are usually caused by a virus and may last from a few days to a week. Infections caused by the flu may take a little longer to clear

up and may sometimes require antibiotics.

Smoking

Smoking is another common cause of coughing. A cough caused by smoking is almost always a chronic cough with a distinctive sound. It's often known as "smoker's cough."

Asthma

A common cause of coughing in young children is asthma. Typically, asthmatic coughing involves wheezing, making it easy to identify. Asthma exacerbations should receive treatment using an inhaler. It's possible for children to grow out of asthma as they get older.

Medicines

Some medications will cause coughing, although this is generally a rare side effect. Angiotensin-converting enzyme (ACE) inhibitors, commonly used to treat high blood pressure and heart conditions, can cause coughing. Two of the more common brands are Zestril (lisinopril) and Vasotec (enalapril). The coughing stops when the medication is discontinued.

Other conditions

Other conditions that may cause a cough include:

✓ damage to the vocal cords

✓ postnasal drip

✓ bacterial infections such as pneumonia, whooping cough, and croup

✓ serious conditions such as pulmonary embolism and heart failure

Another common condition that can cause a chronic cough is gastro esophageal reflux disease (GERD). In this condition, stomach contents flow back into the esophagus.

This backflow stimulates a reflex in the trachea, causing the person to cough.

Emergency issues

Most coughs will clear up, or at least significantly improve, within two weeks. If someone have a cough that hasn't improved in this amount of time, one must see a doctor, as it may be a symptom of a more serious problem.

If additional symptoms develop, such as a fever, chest pains, headaches, drowsiness, or confusion, as soon as possible a doctor should be consulted.

3.7.2.2 Treatments

A cough can be treated in a variety of ways, depending on the cause. For healthy adults, most treatments will involve self-care.

Self-treatment

A cough that results from a virus can't be treated with antibiotics. You can, however, soothe it in the following ways:

✓ Keep hydrated by drinking plenty of water.

✓ Elevate your head with extra pillows when sleeping .

✓ Use cough drops to soothe your throat.

✓ Gargle hot salt water regularly to remove mucus and soothe your throat .

✓ Avoid irritants, including smoke and dust .

✓ Add honey or ginger to hot tea to relieve your cough and clear your airway.

✓ Use decongestant sprays to unblock your nose and ease breathing.

Medical care

If your cough is likely due to bacteria, your doctor will prescribe oral antibiotics. You'll usually need to take the medication for a week to fully cure the cough. They may also prescribe either expectorant cough syrups, or cough suppressants that contain codeine.

If your doctor can't find a cause for your cough, they may order additional tests.

3.7.2.3 Prevention

While infrequent coughing is necessary to clear the airways, there are ways you can prevent catching other coughs.

Quit smoking

Smoking is a common contributor to a chronic cough. It can be very difficult to cure a "smoker's cough."

Dietary changes

People who eat diets high in fruit, fiber, and flavonoids are less likely to suffer from chronic coughs.

Medical conditions

It's advisable to stay away from anyone suffering from contagious illnesses, such as bronchitis, to avoid coming into contact with germs. You should wash your hands frequently, and you shouldn't share cutlery, towels, or pillows.

3.7.3 Fevers

Fever (Fig. 3.6) is when a human's body temperature goes above the normal range of 36-37° Centigrade (98-100^0 Fahrenheit). It is a common medical sign. Other terms for a fever include pyrexia and controlled hyperthermia. As the body temperature goes up, the person may feel cold until it levels off and stops rising.

Fig. 3.6. *Fevers are common but can be unpleasant.*

People's normal body temperatures may vary and are affected by factors such as eating, exercise, sleeping, and what time of the day it is. Our body temperature is usually at its highest at around 6 p.m. and at its lowest at about 3 a.m.

A high body temperature, or fever, is one of the ways our immune system attempts to combat an infection. Usually, the rise in body temperature helps the individual resolve an infection. However, sometimes it may rise too high, in which case, the fever can be serious and lead to complications.

Doctors say that as long as the fever is mild, there is no need to bring it down - if the fever is not severe, it is probably helping to neutralize the bacterium or virus that is causing the infection. Medications to bring down a fever are called antipyretics.

If the fever is causing undue discomfort, an antipyretic may be recommended.

When a fever reaches or exceeds 38° Centigrade (100.4° Fahrenheit), it is no longer mild and should be checked every couple of hours.

These temperatures refer to oral measurement, when the thermometer is put in the mouth. For normal armpit temperatures, the temperature measures lower than it actually is and the numbers are reduced by about 0.2-0.3° Centigrade.

3.7.3.1 Causes

Fever can be caused by a number of factors:

- ✓ an infection, such as strep throat, flu, chickenpox, or pneumonia
- ✓ rheumatoid arthritis
- ✓ some medications
- ✓ overexposure of skin to sunlight, or sunburn
- ✓ heat stroke, resulting either by exposure to high temperatures or prolonged strenuous exercise
- ✓ dehydration
- ✓ silicosis, a type of lung disease caused by long-term exposure to silica dust
- ✓ amphetamine abuse
- ✓ alcohol withdrawal

3.7.3.2 Diagnosis

Diagnosing a fever is straightforward - the patient's temperature is taken, if the reading is high, they have a fever. It is important to take the person's temperature when they are at rest because physical activity can warm us up.

A person is said to have a fever if:

1. The temperature in the mouth is over 37.7° Centigrade (99.9° Fahrenheit).
2. The temperature in the rectum (anus) is over 37.5-38.3° Centigrade (100-101° Fahrenheit).
3. The temperature under the arm or inside the ear is over 37.2 Centigrade (99° Fahrenheit).

Because fever is a sign rather than a disease, when the doctor has confirmed there is an elevated body temperature, certain diagnostic tests may be ordered.

Depending on what other signs and symptoms exist, these may include blood tests, urine tests, x-rays, or other imaging scans.

3.7.3.3 Treatments

Non-steroidal anti-inflammatory drugs (NSAIDs) such as aspirin or ibuprofen can help bring a fever down. However, a mild fever may be helping combat the bacterium or virus that is causing the infection. It may not be ideal to bring it down.

If the fever has been caused by a bacterial infection, the doctor may prescribe an antibiotic.

If a fever has been caused by a cold, which is caused by a viral infection, NSAIDs may be used to relieve uncomfortable symptoms. Antibiotics have no effect against viruses and will not be prescribed by your doctor for a viral infection.

Fluid intake: Anyone with a fever should consume plenty of fluids to prevent dehydration. Dehydration will complicate any illness.

Heat stroke: NSAIDs will not be effective if the person's fever was caused by hot weather or sustained strenuous exercise. The patient needs to be cooled. If they are confused or unconscious, they should be treated by a doctor straight away.

3.8 Summary

I. Health can be defined as physical, mental, and social wellbeing, and as a resource for living a full life.

II. At one end of the continuum is kwashiorkor, characterized by a severe protein deficiency, and at the other is marasmus, an absolute food deprivation with grossly inadequate amounts of both energy and protein.

III. Vitamin A deficiency can result from inadequate intake, fat malabsorption, or liver disorders.

IV. The main symptom of vitamin A deficiency is vision loss and blindness.

V. An iron deficiency occurs when an insufficient amount of iron is absorbed to

meet the body's requirements. This insufficiency may be due to inadequate iron intake, to reduced bioavailability of dietary iron, to increased needs for iron, or to chronic blood loss. When prolonged, iron deficiency leads to iron deficiency anemia.

VI. Iodine is one of the essential elements required for normal human growth and development. Its daily per capita requirement is 150 micrograms. Deficiency of iodine in the diet may result in the development of goiter and other iodine deficiency disorders (IDD) including physical and mental retardation and endemic cretinism.

VII. Hypertension is another name for high blood pressure. It can lead to severe health complications and increase the risk of heart disease, stroke, and sometimes death. Current guidelines recommend that all people, including those with hypertension, engage in at least 150 minutes of moderate intensity, aerobic exercise every week, or 75 minutes a week of high intensity exercise.
People should exercise on at least 5 days of the week as walking, jogging, cycling, or swimming.

VIII. Eating extra calories and fat, the body creates an undesirable rise in blood glucose. If blood glucose isn't kept in check, it can lead to serious problems, such as a high blood glucose level (hyperglycemia) that, if persistent, may lead to long-term complications, such as nerve, kidney and heart damage.

IX. A diabetes diet is based on eating three meals a day at regular times. This helps you better use the insulin that your body produces or gets through a medication.

X. There is no cure for diabetes. Type 2 diabetes can, however, be controlled with weight management, nutrition, and exercise. Unfortunately, type 2 diabetes tends to progress, and diabetes medications are often needed.

XI. Many factors play a role in the development of obesity. Genetic traits can increase the risk in some people.

XII. Smoking is responsible for a heap of other awful diseases, contributing to the tobacco epidemic.

XIII. Drinking too much alcohol on a single occasion or over time - can take a serious toll on your health. Alcohol can effect, brain, heart, liver as well as pancreas and weaken immune system.

XIV. Drug dependence is a state in which individual uses the drug so frequently and consistently that it appears difficult for the person to get along without using the drug. Dependence occurs with a wide range of psychotropic drugs, acting by many different mechanisms.

XV. HIV is a virus that damages the immune system. The immune system helps the body fight off infections. Untreated HIV infects and kills CD4 cells, which are a type of immune cell called T cells. Over time, as HIV kills more CD4 cells, the body is more likely to get various types of infections and cancers. Without treatment, a person with HIV is likely to develop a serious condition called AIDS.

XVI. The common cold, coughs and sore throats and fevers are most likely be frequent concerns. Many of these illnesses can be prevented with the use of medicine or through self care.

Questions

1. Define health. Give an idea about health.
2. How kwashiorkor disease can be prevented? Give their symptom.
3. What is vitamin A deficiency disorder? State their cause and symptom.
4. What is meant by life style related disease? Name one disease and state their symptoms and prevention.
5. What is AIDS? State their cause and treatment.
6. How cold and cough can be treated?

Unit - 4 ❑ Food Hygiene

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4.6. Summary

4.1 Objectives

This unit covers the aspects of Food hygiene under the module food, nutrition and health. Food hygiene is the conditions and measures necessary to ensure the safety of food from production to consumption. After finishing the study material of this unit the reader will be able to

- Explain what is food hygiene?
- Describe how food hygiene can be maintained?

- Discuss the methods of water purification
- Describe food and water borne infections, their symptoms and prevention.
- Discuss about food spoilage
- Describe how food preservation processes stop or slow down food spoilage thus allowing for longer food storage

4.2 Introduction

Food hygiene is concerned with every aspect of food production. The main aim is to promote health. This is the responsibility of everyone in the food industry, from managers to cleaners. All must take great care when it comes to handling and preparing food to prevent unnecessary waste of food, due to spoilage or contamination by moulds, bacteria, physical damage or vermin. Most people think that food hygiene is simply common sense, they try to do the right thing and they certainly do not set out to poison anyone. However, when you work in the food industry you must consider a number of important issues to do with your approach to personal hygiene and kitchen hygiene.

Food hygiene and safety usually refer to contamination with 'microorganisms' or 'microbes'; whereas in communicable diseases, the term 'infectious agents' is preferred.

All over the world specially in developing countries people are seriously affected every day by diseases that are caused by consuming unhygienic and unsafe food. We have to give due emphasis to good hygienic practices to prevent and control food borne diseases. Food borne diseases result from eating foods that contain infectious or toxic substances. The food we eat should be free from contaminants such as microorganisms and toxic chemicals.

Food can become contaminated at any point during slaughtering or harvesting, processing, storage, distribution, transportation and preparation. Lack of adequate food hygiene can lead to food borne diseases and death of the consumer.

4.3. Potable water

Drinking water is also known as potable water. Potable water is water that is considered safe to drink or to use for food preparation, without risk of health problems. It has been treated, cleaned or filtered and that meets local established drinking water

standards. Or, it is assumed to be reasonably free of harmful bacteria and contaminants and also considered safe to use in cooking and baking. Examples of potable water would be tap water from treated municipal water systems, or that has been UV filtered, water distilled, or purified by reverse osmosis.

Non-potable water is generally all raw water that is untreated, such as from lakes, rivers, groundwater, natural springs and ground wells. Such water is not considered potable or safe to drink unless it has passed stringent testing.

Without proper water testing, a body of water carries unknown contaminants and bacteria and is deemed to be non-potable, unless proven otherwise. Although it may taste fine, drinking such water carries uncertain health risks.

Previously treated potable water can also become contaminated and no longer considered potable or drinkable water. An example is when tested municipally treated water results show the presence of harmful contaminants, which may have leached into those reservoirs.

4.3.1 Sources of potable water

Water is a vital element in each of our lives. Not only is it essential to our health, but we also use it for numerous household tasks. Every day we use water for cooking, bathing, and cleaning, and drinking; but how often do we think about its source?

Where does our water come from? How is it treated? How do we know it is safe to drink? To answer these questions, it's important to go back to the basics. There are two main sources of water: surface water and groundwater. Surface Water is found in lakes, rivers, and reservoirs. Groundwater lies under the surface of the land, where it travels through and fills openings in the rocks. The rocks that store and transmit groundwater are called aquifers. Groundwater must be pumped from an aquifer to the earth's surface for use.

Consumers receive their water from one of the two sources: a private well, or a community water system. A household well pumps groundwater for household use. The source of a community water system may be either surface water or groundwater.

Private Household Wells

Indian population relies on individually owned and operated sources of drinking water, such as wells, cistern, and spring. The majority of household wells are found

in rural areas. Those who receive their water from a private well are solely responsible for the safety of the water. But the bulk of the responsibility for caring for the well falls on the well owner. Since the well owner is primarily responsible for the water, it is important to know what poses a threat to the well and the groundwater which is its source. A variety of sources can cause well water to become contaminated.

Tap water and hand pump

For the rural areas of India tap water, well and hand pump constitute a major proportion of main sources of drinking water. In the rural areas, approximately 87.7 percent for rural India is dependent on these sources. For urban areas, the aggregate of tap water, well and hand pump constitute a major proportion of main source of drinking water. Approximately 88.7 percent of urban India depends on these sources.

4.3.1.1 Main source of drinking water

1. The source, which was availed during the greater part of the year, was recorded as the main source.
2. Tap water was bifurcated in two categories –
   - ✓ Tap water from treated source
   - ✓ Tap water from un-treated source
3. Well water was categorized as
   - ✓ covered well
   - ✓ uncovered well
4. Other sources included Hand pump, Tube well/Borehole, Spring, River/Canal, Tank/Pond/Lake and Other sources

4.3.1.2 Drinking water sources in rural India ?

Traditionally, The people is rural areas have obtained water from improtected ponds or tanks, wells and sometimes streams and rivers. These water sources are frequented daily for collection drinking and cooking water and for other purposes.

At national level, main drinking water source is tap water (44% of total households), followed by hand pump/tube well water (42% of total households). Hand pump is the water source that is used the most in rural India, and with those states being

mostly rural, we see a high % of hand pump/tube well water use. Only 4% of households on the country use other sources, like water from lake/pond, springs, river/eanalas etc.

4.3.2 Methods of purification of water at domestic level

Clean, potable drinking water is vital to the survival of virtually all living species.

However, sometimes disaster strikes, contaminating major water sources. It is extremely important to be educated on how to treat contaminated water prior to drinking it.

The methods below include just many ways to purify water at home, be it either for emergency purposes, outdoor survival, or, as some of the methods warrant, everyday use.

Following methods are used generally, either singly or in combinations. These are:

a) Straining

b) Boiling

(b) Chemical Disinfection

(c) Filtration

(a) Straining Water Through Cloth

It is easy to filter water using cloth.This kind of filtration will eliminate the main solid impurities from water as well as any insect larvae that it may contain. The cloth used, preferably cotton must be thick enough to properly retain the impurities. If it is too thick, then filtration will take longer. It must always be washed before and after use. Straining along is not a sufficient form of treatment. Nevertheless, straining water before treating it using one of the other methods will significantly improve the quality of water obtained.

Advantages - simple to use; almost no cost; very useful or even essential for pre-treatment purposes.

Disadvantages - does not eliminate the microbes, and chemical contaminants.

(b) Boiling

Boiling (Fig. 4.1) is quite an effective method of purifying water at home level, if the water is bought to “rolling boil” for 5-10 minutes. It kills all the bacteria’s,

spores, cysts and yields sterilized water. It also removes the temporary hardness of the water by driving off carbon dioxide and precipitating calcium carbonate. However, the taste is altered but it is not harmful. The only disadvantage is that it does not provide any "residual protection" against subsequent microbial contamination of water. Water should be boiled preferably in the same container in which it is to be stored, to avoid contamination during storage. Boiled water may lack taste. This problem can be solved by vigorously shaking the water to re- oxygenate it or by adding a little salt.

Advantages - easy to use; kills almost all pathogens.

Disadvantages - requires fuel (approx 1 kg of wood per litre of water); relatively high cost.

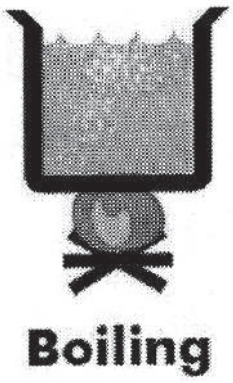

Fig. 4.1 *Water boiling for purification*

(c) Chemical Disinfection

(i) Bleaching Powder

It might sound a little odd, but bleach can, in fact, be used for emergency water purification. However, because it is a chemical, working with bleach can be dangerous, and one must follow careful instructions in order to ensure proper safety and successful water treatment.

First, check to make sure you are using a soap-free and unscented chlorinated bleach. Use a new or sterile medicine drop per to add the following amounts of liquid bleach to the contaminated water:

- 4 to 6% chlorine (most common household bleaches) – Add 8 drops of bleach to each gallon of water
- 1% chlorine – Add 40 drops of bleach to each gallon of water

- 7 to 10% chlorine – Add 4 drops of bleach to each gallon of water.

After the two have been mixed, let the chlorinated water sit for half an hour before drinking. The purified water should slightly smell of chlorine. If it does not, the process may be repeated.

(ii) Readymade chlorine solutions

These are available in different strengths. The chlorine solution is also subject to lose chlorine on exposure to light or prolonged storage. High test hypochlorite (HTH) or Perchloron - it is a calcium compound which contains 60 - 70 percent available chlorine. It is more stable than bleaching powder, hence deteriorates much less on storage.

(iii) Chlorine Tablets

These are available under various trade names e.g. Halazone tablets in the market (Fig. 4.2). These are good for disinfecting small quantities of water, but are expensive. The National Environmental Engineering Research Institute, Nagpur has formulated a new type of chlorine tablet which is available in different strengths in market and are 15 times better than ordinary halogen tablets. A single tablet of 0.5 g is sufficient to disinfect 20 litres of water.

Advantages - muddy water can be made drinkable. If treatment is done properly, all of the pathogens can be eliminated; chlorination has a durable effect.

Disadvantages - handling risks involved, products must be obtained commercially.

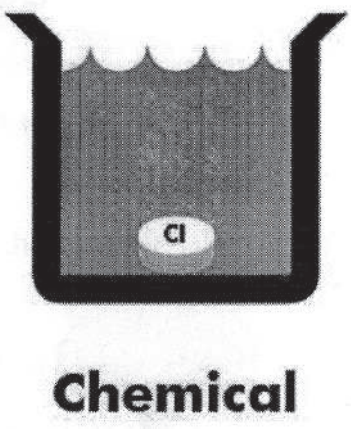

Fig. 4.2 *Adding chemical to water for purification*

(iv) Iodine

In case of emergency, 2 drops of 2 per cent ethanol solution of iodine can be used for a contact period of 20 to 30 minutes to infect one liter of water. High cost, and the fact that it is physiologically active (thyroid activity) are its major disadvantages.

Advantages - persists longer than chlorine and is physiologically active when used wisely according to guidelines.

Disadvantages - careless use may lead to high concentration in drinking water, which may lead to iodine poisoning.

(d) Filtration

Ceramic filters (Fig. 4.3) have been used to treat water for many centuries. Depending on their type, small fixed installations or transportable devices are used to filter water. They often take shape of a pot or a bowl and are impregnated with fine silver colloidal particles serving as disinfectant, stopping the bacterial proliferation in the filter. The filter is installed in a 20-30 L container.

Advantages - easy to use, long life, fairly low cost when filter is made locally. Disadvantages -low production rate (1-2 L per hour); requires filter maintenance (using a cleaning brush).

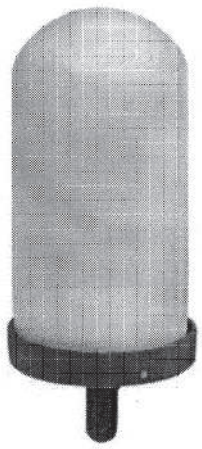

Fig.4.3. *Showing a ceramic filter*

(i) Slow sand filtration

A sand filter is an eco-friendly water treatment tool that is relatively simple and costs little. It works by letting the water percolate through a layer of sand. Two types of slow sand filtration methods are used.

A. Pretreatment sand filer - here the filter serves the same purpose as straining water through cloth. It is generally more effective.

Advantages - easy to use, low cost; suited for emergency situations.

Disadvantages - allows only summary water treatment; only effective in providing pretreatment for solar, chlorination of boiling disinfection methods.

B. Biological sand filter (BSF) - It is a point-of-use water treatment system adopted from traditional low sand filters. It removes pathogens and suspended solids from water using biological and physical processes that takes place in sand column covered with a biofilm. BSFs have been shown to remove heavy metals, turbidity, bacteria, viruses and protozoa.

4.4 Food and water borne infections

Food borne or water borne diseases is caused by consuming contaminated foods or beverages. The illnesses result from the failure to control an identified (or unidentified) hazard.

In its simplest form, a hazard is something that has the potential to cause harm. In food and water, it is an unacceptable contamination that causes the food or water to be unfit for human consumption. A hazard falls into three categories: a) physical b) chemical and c) biological.

Food borne disease has the potential to be caused by all three of these categories of hazards.

Physical food borne illness (injury, in this case) results from foreign objects in food like wood splinters, glass and metal fragments, pebbles or bone fragments.

Chemical illness arises from substances that do not belong in food, but can contaminate it through carelessness or malicious intent or simply by contact with the food. Pesticides and cleaners are some of the chemicals that can cause harm through food. For example, bleach can cause poisoning and should only be kept in a clearly market container to avoid contaminating food.

Biological food borne illness is by far the most common occurrence of food borne illness and is caused by a large number of pathogenic (disease-causing) microganisms (germs), including viruses, bacteria, protozoa, parasites and fungi. A very common virus that causes food borne illness is norovirus (people often call illness caused by this

virus ‘‘stomach flu”, although it is not really a true “flu”, which is a respiratory illness). Salmonella bacteria also commonly cause food borne illness.

4.4.1 Bacterial infections

A bacterial infection is a proliferation of a harmful strain of bacteria on or inside the body. Bacteria can infect any area of the body. Pneumonia, meningitis, and food poisoning are just a few illnesses that may be caused by harmful bacteria.

Bacterial infections are one cause of food borne illness. Nausea, vomiting, diarrhea, fever, chills, and abdominal pain are common symptoms of food poisoning. Raw meat, fish, eggs, poultry, and unpasteurized dairy may harbor harmful bacteria that can cause illness. Unsanitary food preparation and handling can also encourage bacterial growth.

4.4.1.1 Cholera

Cholera is an infectious disease that causes severe watery diarrhea, which can lead to dehydration and even death if untreated. It is caused by eating food or drinking water contaminated with a bacterium called *Vibrio cholera* (Fig. 4.4). The disease is most common in places with poor sanitation, crowding, war, and famine.

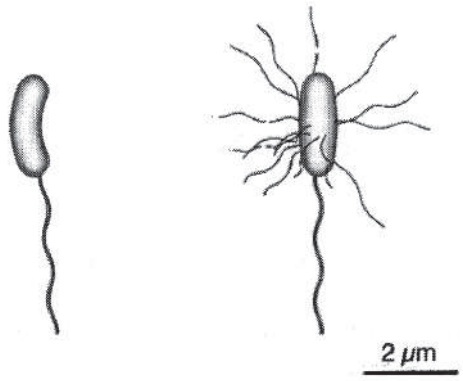

Fig. 4.4 Diagram of the bacterium, *V. cholerae*

4.4.1.1.1 Cholera Causes

Vibrio cholerae, the bacterium that causes cholera, is usually found in food or water contaminated by feces from a person with the infection. Common sources include:

1) Municipal water supplies
2) Ice made from municipal water

3) Foods and drinks sold by street vendors
4) Vegetables grown with water containing human wastes
5) Raw or undercooked fish and seafood caught in waters polluted with sewage

When a person consumes the contaminated food or water, the bacteria release a toxin in the intestines that produces severe diarrhea. It is not likely you will catch cholera just from casual contact with an infected person.

4.4.1.1.2 Cholera Symptoms

Symptoms of cholera can begin as soon as a few hours or as long as five days after infection. Often, symptoms are mild. But sometimes they are very serious. About one in 20 people infected have severe watery diarrhea accompanied by vomiting, which can quickly lead to dehydration. Although many infected people may have minimal or no svmptorr« they can still contribute to spread of the infection.

Signs and symptoms of dehydration include:

1) Rapid heart rate
2) Loss of skin elasticity (the ability to return to original position quickly if pinched)
3) Dry mucous membranes, including the inside of the mouth, throat, nose, and eyelids
4) Low blood pressure
5) Thirst
6) Muscle cramps

If not treated, dehydration can lead to shock and death in a matter of hours.

4.4.1.1.3 Cholera Treatment and Prevention

Although there is a vaccine against cholera, the World Health Organization (WHO) don't normally recommend it, because it may not protect up to half of the people who receive it and it lasts only a few months. However, you can protect yourself and your family by using only water that has been boiled, or has been chemically disinfected, or boiled water. Be sure to use the bottled, boiled, or chemically disinfected water for the following purposes:

a) Drinking
b) Preparing food or drinks

c) Making ice

d) Brushing your teeth

e) Washing your face and hands

f) Washing dishes and utensils that you use to eat or prepare food

g) Washing fruits and vegetables

To disinfect your own water, boil it for one minute (or 3 minutes at higher elevations) or filter it and use a commercial chemical disinfectant. You should also avoid raw foods, including the following:

a) Unpeeled fruits and vegetables

b) Unpasteurized milk and milk products

c) Raw or undercooked meat or shellfish

Hydration is the mainstay of treatment for cholera. Depending on how severe the diarrhea is, treatment will consist of oral (ORS) or intravenous solutions to replace lost fluids. Antibiotics, which kill the bacteria, are not part of emergency treatment for mild cases. But they can reduce the duration of diarrhea by half and also reduce the excretion of the bacteria, thus helping to prevent the spread of the disease.

4.4.1.2 Typhoid fever

Typhoid is a bacterial infection that can lead to a high fever, diarrhea, and vomiting. It can be fatal. It is caused by the bacteria *Salmonella typhi* (Fig. 4.5).

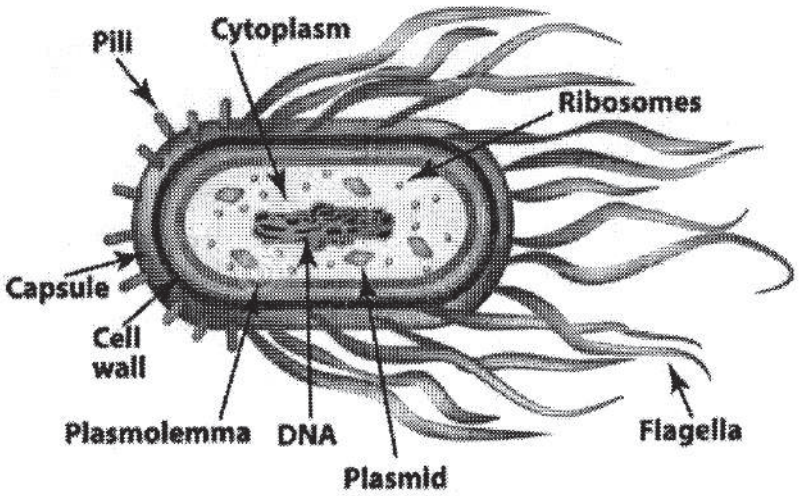

Fig. 4.5 Structure of Salmoella

The infection is often passed on through contaminated food and drinking water, and it is more prevalent in places where hand washing is less frequent. It can also be passed on by carriers who do not know they carry the bacteria. The bacterium lives in the intestines and bloodstream of humans. It spreads between individuals by direct contact with the feces of an infected person.

No animals carry this disease, so transmission is always human to human. If untreated, around 1 in 5 cases of typhoid can be fatal. With treatment, fewer than 4 in 100 cases are fatal.

4.4.1.2.1 Causes

Typhoid is caused by the bacteria *S. typhi* and spread through food, drinks, and drinking water that are contaminated with infected fecal matter. Washing fruit and vegetables can spread it, if contaminated water is used.

Some people are asymptomatic carriers of typhoid, meaning that they harbor the bacteria but suffer no ill effects. Others continue to harbor the bacteria after their symptoms have gone. Sometimes, the disease can appear again.

People who test positive as carriers may not be allowed to work with children or older people until medical tests show that they are clear.

S. typhi enters through the mouth and spends 1 to 3 weeks in the intestine. After this, it makes its way through the intestinal wall and into the bloodstream. From the bloodstream, it spreads into other tissues and organs. The immune system of the host can do little to fight back because *S. typhi* can live within the host's cells, safe from the immune system.

Typhoid is diagnosed by detecting the presence of *S. typhi* via blood, stool, urine, or bone marrow sample.

4.4.1.2.2 Symptoms

Symptoms normally begin between 6 and 30 days after exposure to the bacteria. The two major symptoms of typhoid are fever and rash. Typhoid fever is particularly high, gradually increasing over several days up to 104 degrees Fahrenheit, or 39 to 40 degrees Celsius. The rash, which does not affect every patient, consists of rose-colored spots, particularly on the neck and abdomen. Other symptoms can include:

a) weakness
b) abdominal pain

c) constipation

d) headaches

Rarely, symptoms might include confusion, diarrhea, and vomiting, but this is not normally severe. In serious, untreated cases, the bowel can become perforated. This can lead to peritonitis, an infection of the tissue that lines the inside of the abdomen, which has been reported as fatal in between 5 and 62 percent of cases.

4.4.1.2.3 Treatments

Typhoid fever is treated with antibiotics. Resistance to antibiotics is increasing in the bacteria that cause typhoid fever and paratyphoid fever. When bacteria are resistant to antibiotics, the bacteria are not killed and their growth is not stopped. To help guide treatment, your doctor may order special tests to see if your type of *Salmonella* is antibiotic-resistant.

People who do not get treatment can continue to have fever for weeks or months, and can develop complications. As many as 30% of people who do not get treatment may even die from complications of the infection.

4.4.1.2.4 Prevention

Two basic actions can protect you:

1. Get vaccinated against typhoid fever.
2. Find out how to stay safe when it comes to foods and drinks.

Carefully selecting what you eat and drink when you travel is important. This is because the typhoid fever vaccines do not work 100% of the time, and there is no paratyphoid fever vaccine. Avoiding risky foods will also help protect you from other illnesses, including travelers' diarrhea, cholera, dysentery, and hepatitis A.

1) If you drink water, buy it bottled or bring it to a rolling boil for 1 minute before you drink it. Bottled carbonated water is safer than uncarbonated water.
2) Ask for drinks without ice, unless the ice is made from bottled or boiled water. Avoid popsicles and flavored ices that may have been made with contaminated water.
3) Eat foods that have been thoroughly cooked and are still hot and steaming.

4) Avoid raw vegetables and fruits that cannot be peeled. Lettuce can remain contaminated even after it is washed.

5) When you eat raw fruit or vegetables that can be peeled, peel them yourself. (Wash your hands with soap first.)

6) Avoid foods and beverages from street vendors.

4.4.1.3 Dysentery

Dysentery is an intestinal infection that causes severe diarrhea with blood. In some cases, mucus may be found in the stool. This usually lasts for 3 to 7 days.

Other symptoms may include:

a) abdominal cramps or pain

b) nausea

c) vomiting

d) fever of 100.4°F (38°C) or higher

e) dehydration, which can become life-threatening if left untreated

Dysentery is usually spread as a result of poor hygiene. For example, if someone who has dysentery doesn't wash their hands after using the toilet, anything they touch is at risk.

The infection is also spread through contact with food or water that has been contaminated with fecal matter. Careful hand washing and proper sanitation can help prevent dysentery and keep it from spreading.

4.4.1.3.1 Causes

The World Health Organization (WHO) identifies two main types of dysentery.

1) Bacillary dysentery or shigellosis

This type produces the most severe symptoms. It is caused by the *Shigella bacillus*. Poor hygiene is the main source. Shigellosis can also spread because of tainted food.

2) Amoebic dysentery or amoebiasis

This type is caused by *Entamoeba histolytica (E. histolytica),* an amoeba. The amoebae group together to form a cyst and these cysts emerge from the body in human feces.

In areas of poor sanitation, the amoebae can contaminate food and water and infect other humans, as they can survive for long periods outside the body. They can also linger on people's hands after using the bathroom. Good hygiene practice reduces the risk of spreading infection.

Other causes

Other causes include a parasitic worm infection, chemical irritation, or viral infection.

4.4.1.3.2 Symptoms

The symptoms of dysentery range from mild to severe, largely depending on the quality of sanitation in the areas where infection has spread.

In developed countries, signs and symptoms of dysentery tend to be milder than in developing nations or tropical areas.

Mild symptoms include:

- a slight stomach-ache
- cramping
- diarrhea

These usually appear from 1 to 3 days after infection, and the patient recovers within a week. Some people also develop lactose intolerance, which can last for a long time, sometimes years.

Symptoms of bacillary dysentery

Symptoms tend to appear within 1 to 3 days of infection. There is normally a mild stomach ache and diarrhea, but no blood or mucus in the feces. Diarrhea may be frequent to start with. Less commonly, may be:

a) blood or mucus in the feces

b) intense abdominal pain

c) fever

d) nausea

e) vomiting

Often, symptoms are so mild that a doctor's visit is not required, and the problem resolves in a few days.

Symptoms of amoebic dysentery

A person with amoebic dysentery may have:

a) abdominal pain

b) fever and chills

c) nausea and vomiting

d) watery diarrhea, which can contain blood, mucus, or pus

e) the painful passing of stools

f) fatigue

g) intermittent constipation

If amoeba tunnel through the intestinal wall, they can spread into the bloodstream and infect other organs. Ulcers can develop. These may bleed, causing blood in stools.

Symptoms may persist for several weeks.

The amoebae may continue living within the human host after symptoms have gone. Then, symptoms may recur when the person's immune system is weaker.

Treatment reduces the risk of the amoebae surviving.

4.4.1.3.3 Treatment

Laboratory results will reveal whether the infection is due to *Shigella* or *Entamoeba histolyca* infection. If treatment is necessary, it will depend on these results. However, any patient with diarrhea or vomiting should drink plenty of fluids to prevent dehydration.

If they are unable to drink, or if diarrhea and vomiting are profuse, intravenous (IV) fluid replacement may be necessary. The patient will be placed on a drip and monitored.

Treatment for mild bacillary dysentery

Mild bacillary dysentery, the kind commonly found in developed countries with good sanitation, will normally resolve without treatment. However, the patient should drink plenty of fluids. In more severe cases, antibiotic drugs are available.

Treatment for amoebic dysentery

Amoebicidal medications are used to treat *Entamoeba histolyca.* These will ensure that the amoeba does not survive inside the body after symptoms have resolved. Flagyl, or metronidazole, is often used to treat dysentery. It treats both bacteria and parasites.

If lab results are unclear, the patient may be given a combination of antibiotic and amoebicidal medications, depending on how severe their symptoms are.

4.4.1.3.4 Prevention

Dysentery mostly stems from poor hygiene.To reduce the risk of infection, people should wash their hands regularly with soap and water, especially before and after using the bathroom and preparing food.This can reduce the frequency of *Shigella* infections and other types of diarrhea by up to 35 percent.

Other steps to take when the risk is higher, for example, when traveling, include:

a) Only drink reliably sourced water, such as bottled water

b) Watch the bottle being opened, and clean the top ofthe rim before drinking

c) Make sure food is thoroughly cooked

It is best to use purified water to clean the teeth, and avoid ice cubes, as the source of the water may be unknown.

4.4.2 Viral infection

Most people have a body temperature of about 98.6°F (37°C). Anything a degree above this is considered a fever. Fevers are often a sign that your body is fighting off some type of bacterial or viral infection. A viral fever is any fever that's caused by an underlying viral illness.

A variety of viral infections can affect humans, from the common cold to the flu. A low-grade fever is a symptom of many viral infections. But some viral infections, such as dengue fever, can cause a higher fever.

A viral fever is caused by infection with a virus. Viruses are very small infectious agents. They infect and multiply within the cells of your body. A fever is your body's way of fighting off a virus. Many viruses are sensitive to shifts in temperature, so a sudden increase in your body temperature makes you less hospitable to viruses.

4.4.2.1 Hepatitis

Hepatitis refers to an inflammation of the liver cells and damage to the liver. There are different types and causes, but the symptoms can be similar. The liver's functions include detoxifying the blood, storing vitamins, and producing hormones. Hepatitis can disrupt these processes and create severe health problems throughout the body.

At least five viruses can cause hepatitis. The three most common are hepatitis viruses A, B and C. Infection with any of these three can be fatal. Each is caused by a different virus. All three types can be acute, lasting for 6 months or less, and types B and C can be chronic, lasting for longer. Each type has different characteristics and is transmitted in different ways, but symptoms tend to be similar (Fig. 4.6).

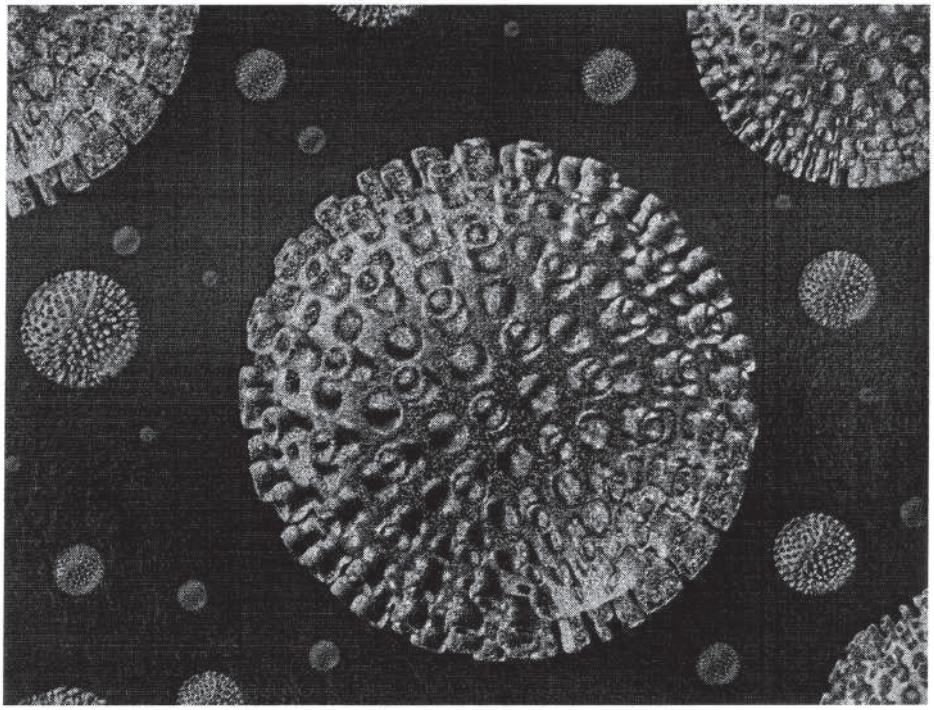

Fig. 4.6 *showing hepatitis virus*

Hepatitis A is always an acute, short-term disease, while hepatitis B, C, and D are most likely to become ongoing and chronic. Hepatitis E is usually acute but can be particularly dangerous in pregnant women.

Other types of hepatitis can result from overconsumption of alcohol or an autoimmune condition.

4.4.2.1.1 Causes

Hepatitis A

Hepatitis A is caused by an infection with the hepatitis A virus (HAV). This type of hepatitis is most commonly transmitted by consuming food or water contaminated by feces from a person infected with hepatitis A.

Hepatitis B

Hepatitis B is transmitted through contact with infectious body fluids, such as blood, vaginal secretions, or semen, containing the hepatitis B virus (HBV). Injection drug use, having sex with an infected partner, or sharing razors with an infected person increase your risk of getting hepatitis B.

Hepatitis C

Hepatitis C comes from the hepatitis C virus (HCV). Hepatitis C is transmitted through direct contact with infected body fluids, typically through injection drug use and sexual contact. HCV is among the most common blood borne viral infections.

Hepatitis D

Also called delta hepatitis. Hepatitis D is a serious liver disease caused by the hepatitis D virus (HDV). HDV is contracted through direct contact with infected blood.

Hepatitis D is a rare form of hepatitis that only occurs in conjunction with hepatitis B infection. The hepatitis D virus can't multiply without the presence of hepatitis B.

Hepatitis E

Hepatitis E is a water borne disease caused by the hepatitis E virus (HEV). Hepatitis E is mainly found in areas with poor sanitation and typically results from ingesting fecal matter that contaminates the water supply.

4.4.2.1.2 Symptoms

If you have infectious forms of hepatitis that are chronic, like hepatitis Band C, you may not have symptoms in the beginning. Symptoms may not occur until the damage affects liver function.

Signs and symptoms of acute hepatitis appear quickly. They include:

a) fatigue

b) flu-like symptoms

c) dark urine

d) pale stool

e) abdominal pain

f) loss of appetite

g) unexplained weight loss

h) yellow skin and eyes, which may be signs of jaundice

Chronic hepatitis develops slowly, so these signs and symptoms may be too subtle to notice.

4.4.2.1.3 Treatment

Treatment options are determined by which type of hepatitis you have and whether the infection is acute or chronic.

Hepatitis A

Hepatitis A usually doesn't require treatment because it's a short-term illness. Bed rest may be recommended if symptoms cause a great deal of discomfort. If you experience vomiting or diarrhea, follow your doctor's orders for hydration and nutrition.

The hepatitis A vaccine is available to prevent this infection. Most children begin vaccination between ages 12 and 18 months. It's a series of two vaccines. Vaccination for hepatitis A is also available for adults and can be combined with the hepatitis B vaccine.

Hepatitis B

Acute hepatitis B doesn't require specific treatment. Chronic hepatitis B is treated with antiviral medications. This form of treatment can be costly because it must be continued for several months or years. Treatment for chronic hepatitis B also requires regular medical evaluations and monitoring to determine if the virus is responding to treatment.

Hepatitis B can be prevented with vaccination for all newborns. The series of three vaccines is typically completed over the first six months of childhood. The vaccine is also recommended for all healthcare and medical personnel.

Hepatitis C

Antiviral medications are used to treat both acute and chronic forms of hepatitis C. People who develop chronic hepatitis C are typically treated with a combination of antiviral drug therapies. They may also need further testing to determine the best form of treatment. People who develop cirrhosis (scarring of the liver) or liver disease as a result of chronic hepatitis C may be candidates for a liver transplant.

Currently, there is no vaccination for hepatitis C.

Hepatitis D

No antiviral medications exist for the treatment of hepatitis D at this time. Hepatitis D can be prevented by getting the vaccination for hepatitis B, as infection with hepatitis B is necessary for hepatitis D to develop.

Hepatitis E

Currently, no specific medical therapies are available to treat hepatitis E. Because the infection is often acute, it typically resolves on its own. People with this type of infection are often advised to get adequate rest, drink plenty of fluids, get enough nutrients, and avoid alcohol. However, pregnant women who develop this infection require close monitoring and care.

4.4.2.1.4 Prevention

Hygiene

Practicing good hygiene is one key way to avoid contracting hepatitis A and E. If you're traveling to a developing country, you should avoid:

a) local water

b) ice

c) raw or undercooked shellfish and oysters

d) raw fruit and vegetables

Hepatitis B, C, and D contracted through contaminated blood can be prevented by:

a) not sharing drug needles

b) not sharing razors

c) not using someone else's toothbrush

d) not touching spilled blood

Hepatitis Band C can also be contracted through sexual intercourse and intimate sexual contact. Practicing safe sex by using condoms and dental dams can help decrease the risk of infection.

Vaccines

The use of vaccines is an important key to preventing hepatitis. Vaccinations are available to prevent the development of hepatitis A and B. Experts are currently developing vaccines against hepatitis C.

4.4.2.2 Poliomyelitis

Polio, also known as poliomyelitis (Fig.4.7) and infantile paralysis, is a highly contagious viral infection that can lead to paralysis, breathing problems, or even death.

Polio can be classified as occurring with or without symptoms. About 95 percent of all cases are asymptomatic, and between 4 and 8 percent of cases are symptomatic. Polio is a viral infection that can cause paralysis and death in its most severe forms. It can spread easily from person to person.

Fig.4.7 A case of poliomyelitis

The World Health Organization (WHO) aim is to eradicate polio completely and, if this happens, it will be only the third disease to have been beaten in this way, after smallpox and rinderpest.

4.4.2.2.1 Causes

The poliovirus spreads most often from fecal-oral contact. In addition, because polio is so contagious, direct contact with a person infected with the virus can cause

polio. In areas with poor sanitation, the virus easily spreads from feces into the water supply, or, by touch, into food. People carrying the poliovirus can spread the virus for weeks in their feces. People who have the virus but don't have symptoms can pass the virus to others.

Usually, this occurs from poor hand washing or from consuming of contaminated food or water. Sneezing or coughing also spreads the virus. Your child is most contagious immediately before any symptoms show up and soon after they appear.

Once the virus has entered an individual, it infects the cells of the throat and intestine. The virus stays within the intestines, before spreading to other areas of the body. Eventually, the virus moves into the bloodstream where it can spread to the entire body.

4.4.2.2.2 Symptoms

Polio, in its most severe forms, can cause paralysis and death. However, most people with polio do not display any symptoms or become noticeably sick. When symptoms do appear, they differ depending on the type of polio.

Symptomatic polio can be broken down further into a mild form, called non-paralytic or abortive polio, and a severe form called paralytic polio that occurs in around 1 percent of cases.

Many people with non-paralytic polio make a full recovery. Unfortunately, those with paralytic polio generally develop permanent paralysis.

Non-paralytic polio symptoms

Non-paralytic polio, also called abortive poliomyelitis, leads to flu-like symptoms that last for a few days or weeks. These include:

a) fever

b) sore throat

c) headache

d) vomiting

e) fatigue

f) back and neck pain

g) arm and leg stiffness

h) muscle tenderness and spasms

i) meningitis, an infection of the membranes surrounding the brain

Paralytic polio symptoms

Paralytic polio affects only a small percentage of those invaded by the polio virus. In these cases, the virus enters motor neurons where it replicates and destroys the cells. These cells are in the spinal cord, brain stem, or motor cortex, which is an area of the brain important in controlling movements.

Symptoms of paralytic polio often start in a similar way to non-paralytic polio, but later progress to more serious symptoms such as:

a) a loss of muscle reflexes

b) severe muscle pain and spasms

c) loose or floppy limbs that are often worse on one side of the body

Paralytic polio may also be classified as:

- **Spinal polio:** The virus attacks motor neurons in the spinal cord that causes paralysis in the arms and legs, and breathing problems.
- **Bulbar polio:** The virus affects the neurons responsible for sight, taste, swallowing, and breathing.
- **Bulbospinal polio:** The virus causes symptoms of both spinal and bulbar polio.

4.4.2.2.3 Treatment

Vaccine

There are two vaccines available to fight polio:

✓ inactivated poliovirus (IPV)

✓ oral polio vaccine (OPV)

IPV consists of a series of injections that start 2 months after birth and continue until the child is 4 to 6 years old. The vaccine is made from inactive poliovirus. It is very safe and effective and cannot cause polio.

OPV is created from a weakened form of poliovirus. This version is the vaccine of choice **(Fig. 4.8)** in many countries because it is low cost, easy to administer, and gives an excellent level of immunity. However, in very rare cases, OPV has been known to revert to a dangerous form of poliovirus, which is able to cause paralysis.

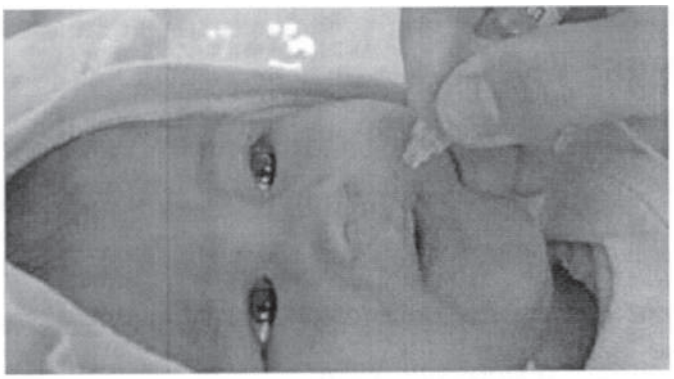

Fig. 4.8 using polio drops

Polio vaccinations, or boosters, are highly recommended for anyone who is not vaccinated or is unsure whether they are. Because there is no cure for polio once a person develops the virus, treatments are focused on increasing comfort, managing symptoms, and preventing complications. This can include bed rest, antibiotics for additional infections, painkillers, ventilators to help breathing, physiotherapy, moderate exercise, and a proper diet.

Historically, a person who developed lung paralysis due to polio was placed into an iron lung, a device that would push and pull chest muscles to make them work. However, more modern portable ventilators and jacket-type ventilators are now used instead.

4.4.2.2.4 Prevention

Vaccines are the main way to prevent polio.

However, other methods of limiting the spread of this potentially fatal disease include:

1) avoiding food or beverages that may have been contaminated by a person with poliovirus
2) checking with a medical professional that your vaccinations are current
3) being sure to receive any required booster doses of the vaccine
4) washing your hands frequently
5) using hand sanitizer when soap is not available
6) making sure you only touch the eyes, nose, or mouth with clean hands

7) covering the mouth while sneezing or coughing

8) avoiding close contact with people who are sick, including kissing, hugging, and sharing utensils

Be sure to receive a vaccination before traveling to an area that is prone to polio breakouts.

4.4.3. Protozoan Infection

Protozoa is a single-celled organism that is a eukaryote. Protozoa are found everywhere. They can live on their own as free-living organisms in the environment, often in the soil, water, or moss. They can also be resting cysts, which lets them survive through dry times. Some are parasites. Others live in symbiosis with other organisms; each relies on the other for survival.

Infections caused by protozoa can be spread through ingestion of cysts (the dormant life stage), sexual transmission, or through insect vectors. There are many common - and not so common - infections caused by protozoa. Some of these infections cause illness in millions of people each year; other infections are rare and hopefully disappearing.

Common infectious diseases caused by protozoans include malaria, giardia, and toxoplasmosis. These infections are found in very different parts of the body - malaria infections start in the blood, giardia starts in the gut, and toxoplasmosis can be found in lymph nodes, the eye, and also worrisomely the brain.

Entamoeba histolytica can cause diarrhea and GI upset. It can, in fact, cause amoebic dysentery in severe cases, as well as asymptomatic cases for others. It can also travel through the walls of the intestines and go into the bloodstream and on to other organs, like the liver, where it can create liver abscesses.

4.4.3.1 Amoebiasis

Amoebiasis is a parasitic infection of the intestines caused by the protozoan *Entamoeba histolytica,* or *E. histolytica* or another amoeba (for example, *E. dispar);* the disease may be asymptomatic in most individuals. *E. histolytica* is the species that produces symptoms only in about 10% of those infected. The symptoms of amoebiasis include loose stool, abdominal cramping, and stomach pain. However, most people with amebiasis won't experience significant symptoms.

Amoebiasis is common in tropical countries with underdeveloped sanitation. It's most common in the Indian subcontinent, parts of Central and South America, and parts of Africa. It is estimated that amoebiasis causes 50,000-100,000 deaths worldwide each year.

4.4.3.1.1 Causes and sources of infection

The cause of amoebiasis is infection by the protozoan parasite *Entamoeba histolytica;* it begins when the cystic form (infective stage) is ingested when the person drinks contaminated water or eats contaminated foods, comes in contact with contaminated colonic irrigation devices or the contaminated hands of food handlers, or by anal sexual practices.

When cysts (Fig. 4.9) enter the body, they lodge in the digestive tract. They then release an invasive, active form of the parasite called a trophozite. The parasites reproduce in the digestive tract and migrate to the large intestine. There, they can burrow into the intestinal wall or the colon. This causes bloody diarrhea, colitis, and tissue destruction. These trophozoites can reach the portal blood circulation to the liver and eventually go to other organs.The infected person can then spread the disease by releasing new cysts into the environment through infected feces.

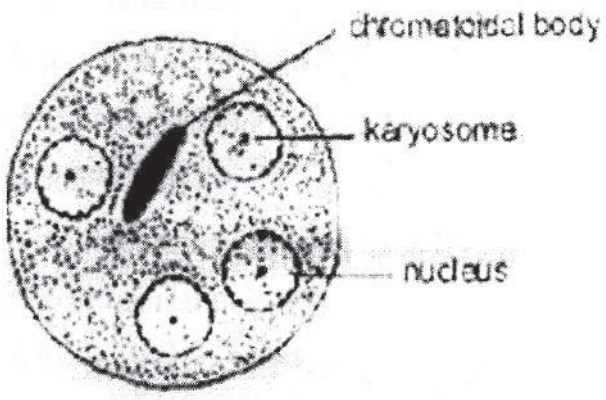

***Fig.* 4.9** *Mature quadrinucleate cyst of Entamoeba histolytica*

4.4.3.1.2 Symptoms

When symptoms occur, they tend to appear 1 to 4 weeks after ingestion of the cysts. Only about 10 to 20 percent of people who have amebiasis become ill from it. Symptoms at this stage tend to be mild and include loose stools and stomach cramping.

Once the trophozites have breached the intestinal walls, they can enter the bloodstream and travel to various internal organs. They can end up in your liver, heart, lungs, brain, or other organs. If trophozites invade an internal organ, they can potentially cause:

a) abscesses

b) infections

c) severe illness

d) death

If the parasite invades the lining of your intestine, it can cause amebic dysentery. Amebic dysentery is a more dangerous form of amebiasis with frequent watery and bloody stools and severe stomach cramping.

The liver is a frequent destination for the parasite. Symptoms of amebic liver disease include fever and tenderness in the upper-right part of your abdomen.

4.4.3.1.3 Treatment

Treatment for uncomplicated cases of amoebiasis generally consists of a 10-day course of metronidazole (Flagyl) that can be taken as a capsule. Flagyl is recommended even for amoebic liver abscesses (up to 10 cm sized abscesses). Tinidazole (Tindamax) is FDA approved for treatment of both intestinal and extra intestinal (invasive) amoebiasis.

Amoebic colitis can be treated with nitroimidazoles, but they should be followed up by a luminal agent. Treatment of hepatic amoebiasis has been successful in some patients with chloroquine (Aralen) or dehydroemetine (This is not a preferred treatment because of potential heart toxicity). Doctor may also prescribe medication to control nausea if require.

If the parasite is present in your intestinal tissues, the treatment must address not only the organism but also any damage to the infected organs. Surgery may be necessary if the colon or peritoneal tissues have perforations.

4.4.3.1.4 Prevention

Amoebiasis can be prevented by stopping the fecal contamination of food and water by correcting poor sanitation. Proper sanitation is the key to avoiding amoebiasis. As a general rule, thoroughly wash hands with soap and water after using the bathroom

and before handling food. Identification and treatment of food handlers or other carriers of the parasite can reduce the chance of getting food-borne amoebiasis. Avoiding sexual practices that involve fecal-oral contact also may reduce the chance of getting the disease. Avoiding malnutrition and alcohol use can reduce risk of the disease.

If you're traveling to places where the infection is common, follow this regimen when preparing and eating food:

a) Thoroughly wash fruits and vegetables before eating.

b) Avoid eating fruits or vegetables unless you wash and peel them yourself.

c) Stick to bottled water and soft drinks.

d) If you must drink water, boil it or treat it with iodine.

e) Avoid ice cubes or fountain drinks.

f) Avoid milk, cheese, or other unpasteurized dairy products.

g) Avoid food sold by street vendors.

4.4.3.2 Giardiasis

Giardia infection or giardiasis is an intestinal infection marked by abdominal cramps, bloating, nausea and bouts of watery diarrhea. It is an infection of small intestine. It's caused by a microscopic parasite called *Giardia lamblia.* Giardiasis spreads through contact with infected people. And one can get giardiasis by eating contaminated food or drinking contaminated water. Pet dogs and cats also frequently contract giardia.

Giardia infections usually clear up within a few weeks. But you may have intestinal problems long after the parasites are gone. Several drugs are generally effective against giardia parasites, but not everyone responds to them. Prevention is your best defense.

4.4.3.2.1 Causes and sources of infection

Giardia parasites live in the intestines of people and animals. Before the microscopic parasites are passed in stool, they become encased within hard shells called cysts, which allows them to survive outside the intestines for months. Once inside a host, the cysts dissolve and the parasites are released.

Infection occurs when you accidentally ingest the parasite cysts (Fig. 4.10). This can occur by swallowing contaminated water, by eating contaminated food or through person- to-person contact.

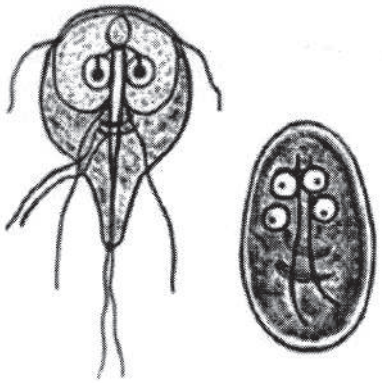

Fig. 4.10 *Giardia lamblia,* trophozoit and cyst

Swallowing contaminated water

The most common way to become infected with giardia is after swallowing contaminated water. Giardia parasites are found in lakes, ponds, rivers and streams worldwide, as well as in municipal water supplies, wells, cisterns, swimming pools, water parks and spas. Ground and surface water can become contaminated from agricultural runoff, wastewater discharge or animal feces. Children in diapers and people with diarrhea may accidentally contaminate pools and spas.

Eating contaminated food

Giardia parasites can be transmitted through food - either because food handlers with giardiasis don't wash their hands thoroughly or because raw produce is irrigated or washed with contaminated water. Because cooking food kills giardia, food is a less common source of infection than water is, especially in industrialized countries.

Person-to-person contact

You can contract giardiasis if your hands become contaminated with fecal matter - parents changing a child's diapers are especially at risk. So are child care workers and children in child care centers, where outbreaks are increasingly common. The giardia parasite can also spread through anal sex.

4.4.3.2.2 Symptoms

Some people can carry giardia parasites without experiencing any symptoms.

Symptoms of giardiasis generally show up one or two weeks after exposure. Common symptoms include:

a) fatigue

b) nausea

c) diarrhea or greasy stools

d) loss of appetite

e) vomiting

f) bloating and abdominal cramps

g) weight loss

h) excessive gas

i) headaches

j) abdominal pain

4.4.3.2.3 Treatment

Many people get better without treatment. But if your symptoms last more than several weeks, or you're likely to spread the parasite, doctor can give medication. Metronidazole (Flagyl), nitazoxanide (Alinia), and tinidazole(Tindamax) are among the drugs used to treat giardia infections.

4.4.3.2.4 Prevention

There isn't a vaccine, but there are steps that can be taken:

1) **Practice good hygiene:** Wash hands often with soap and clean running water for 20 seconds, especially before and after eating, after using the toilet, and after coming in contact with your own or someone else's germs.

2) **Do not drink water that may be contaminated:** Do not drink untreated water from pools, lakes, rivers, ponds, and so on. If there is even a slight chance the water may be contaminated, either drink bottled water or boil the water for 5 minutes.

3) **Avoid eating food that may be contaminated:** Wash all fruits and vegetables thoroughly under hot water. Do not eat raw or undercooked meats, especially in underdeveloped countries where the water and food may be contaminated. Drink bottled water when in underdeveloped countries.

4) **Prevent contact with feces during sex:** Practice safe sex, especially using protection during oral-anal sex, and wash hands immediately after.

5) **Clean up after sick pets:** Use gloves and dispose of pet feces in a plastic bag and put it in the garbage. After, wipe up the infected area with hot steaming water and a strong disinfectant. Wash anything that may have been contaminated in the washer with detergent and hot water.

4.4.4 Parasitic Infection

A parasite is an organism that lives on or inside another organism (the host) and benefits (for example, by getting nutrients) from the host at the host's expense. Although this definition actually applies to many microbes, including bacteria, fungi, and viruses, doctors use the term "parasites" to refer to

a) Protozoa (such as amoebas), which consist of only one cell

b) Worms (helminths), which are larger and consist of many cells and have internal organs

Parasites are organisms that live off other organisms, or hosts, to survive. Some parasites don't noticeably affect their hosts. Others grow, reproduce, or invade organ systems that make their hosts sick, resulting in a parasitic infection.

Parasitic infections can be spread in a number of ways. For example, protozoa and helminths can be spread through contaminated water, food, waste, soil, and blood. Some can be passed through sexual contact. Some parasites are spread by insects that act as a vector, or carrier, of the disease. For example, malaria is caused by parasitic protozoa that are transmitted by mosquitoes when they feed on humans.

4.4.4.1 Taeniasis (Tape worm)

Taeniasis is an intestinal infection caused by adult tapeworms. Taeniasis is caused by eating undercooked beef or pork that contains tapeworm eggs. Most cases of the infection do not cause symptoms. In severe or chronic cases, symptoms may include stomach pain, lost appetite, weight loss and an upset stomach. Tapeworm segments may be visible as they pass through the anus and in the faeces.

Three tapeworm species cause taeniasis in humans, *Taenia solium, Taenia saginata* and *Taenia asiatica.* Only *T. solium* causes major health problems. *T. solium* taeniasis

is acquired by humans through the ingestion of tapeworm larval cysts (cysticerci) in undercooked and infected pork. Human tapeworm carriers excrete tapeworm eggs in their faeces and contaminate the environment when they defecate in open areas. Humans can also become infected with *T. solium* eggs by ingesting contaminated food or water or because of poor hygiene via the fecal-oral route.

Medications are used to treat taeniasis. Adequate sanitation and cooking meat to safe temperatures can help prevent it.

4.4.4.1.1 Transmission and source of infection

Eggs of *T. saginata* passed in the faeces of an infected person are only infectious to cattle. Humans are infected by ingestion of raw or undercooked beef infected with *Cysticercus bovis,* the larval stage of *T. saginata.* In humans, the adult tapeworm develops in the intestine over 2-3 months. The cycle of infection repeats when infectious eggs are passed in the faeces and later ingested by cattle, slowly migrating into the flesh and transforming into the larval stage.

Infections by *T. solium* may follow a similar cycle, with consumption of infected pork leading to the subsequent development of adult tapeworms. However, human infection may also occur through the consumption of *T. solium* eggs. This occurs by direct transfer from the faeces of an infected person, or through ingestion of contaminated food or water. When the eggs of *T. solium* are ingested by either humans or pigs, the embryos escape the shells and penetrate the intestinal wall, with subsequent spread of larvae to various tissues to produce cysticercosis.

T. saginata is not directly transmissible from person to person, but *T. solium* may be. Adult tapeworms may persist in the intestines for up to 30 years and are able to disseminate eggs for all of this time. Eggs may remain viable in the environment for months.

4.4.4.1.2 Causes of Taeniasis

Taeniasis is caused by a cestode (tapeworm), either *Taenia saginata* (beef tapeworm), or *Taenia solium* (pork tapeworm). You can develop taeniasis by eating raw or undercooked beef or pork. Contaminated food can contain tapeworm eggs or larvae that grow in your intestines when eaten. Fully cooking beef or pork will destroy the larvae so that they can't live in your body. The tapeworm (**Fig. 4.11**) can grow up to 12 feet in length. It can live in the intestines for years without being discovered. Tapeworms have segments along their bodies. Each of these segments

can produce eggs. As the tapeworm matures, these eggs will be passed out of the body in the stool.

Poor hygiene can also cause the spread of taeniasis. Once tapeworm larvae are in human stool, they can be spread through contact with the stool. You should wash your hands properly to help prevent the spread of the infection.

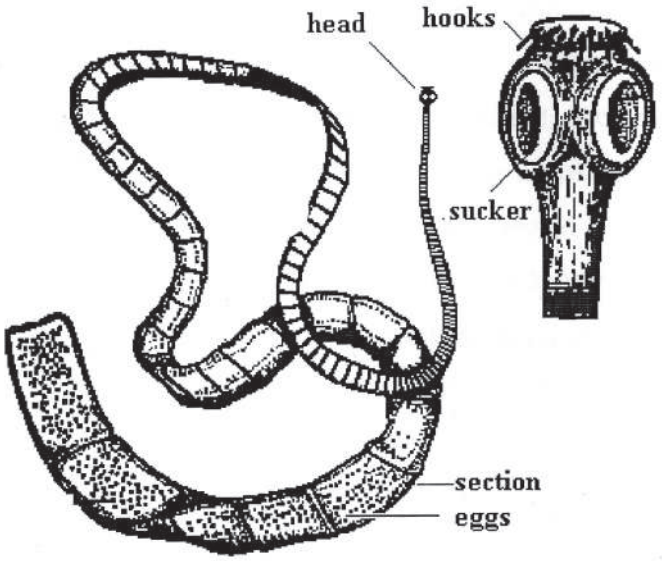

Fig. 4.11 Tapeworm and its head (right side)

4.4.4.1.3 Symptoms

Most people who have taeniasis don't have any symptoms. If signs and symptoms are present, they may include:

a) pain

b) unexplained weight loss

c) blockage of the intestine

d) digestive problems

Some people with taeniasis may also experience irritation in the perianal area, which is the area around the anus. Worm segments or eggs being expelled in the stool cause this irritation.

People often become aware that they have a tapeworm when they see worm segments or eggs in their stool. Infections can take between 8 and 14 weeks to develop.

4.4.4.1.4 Prevention

Intestinal *T. solium* infection can be prevented by cooking whole cuts of pork to $\geq 63^0$ C ($\geq 145^0$ F) as measured with a food thermometer placed in the thickest part of the meat, then allowing the meat to rest for 3 minutes before carving or consuming. Ground pork should be cooked to $\geq 71^o$ C ($\geq 160^o$ F). Ground pork does not require a rest period.

Identifying and treating carriers of adult *T. solium* is an important public health measure in preventing cysticercosis. Careful handwashing is important, especially for food handlers.

When traveling to endemic areas with poor sanitation, people should be careful to avoid foods that might be contaminated by human feces and avoid raw and inadequately cooked pork.

4.4.4.2 Ascariasis (round worm)

Ascariasis is an infection of the small intestine caused by *Ascaris lumbricoides,* which is a species of roundworm and acts as a parasite, getting nutrients from its host's intestinal tract. Infections caused by roundworms are fairly common. Ascariasis is the most common roundworm infection.

The roundworm lays eggs, which then pass in the person's stool, or poop. It can spread when an infected person defecates near farmland or crops. When people do not wash crops or cook them thoroughly, the roundworm can enter a new host, and start its life cycle again.

Many people with ascariasis do not experience any symptoms until the infection has become severe. About 10 percent Trusted Source of the developing world is infected with intestinal worms, according to the World Health Organization (WHO).

4.4.4.2.1 Mode of transmission of Ascaris

Transmission occurs when eggs are swallowed from soil contaminated with human faeces or consumed with produce contaminated with soil containing infective eggs. Transmission does not occur from direct person-to-person contact or from fresh faeces.

4.4.4.2.2 Causes

Human feces can cause contamination if an infected person defecates near a farming field or water source, or if they use untreated feces as a fertilizer for crops.

A person can contact ascariasis by eating or drinking contaminated food or water, especially if they do not adequately wash the food or their hands.

Children may be contaminated by playing with soil or plants and putting their hands in their mouths.

4.4.4.2.3 Sources of infection

The main reservoirs of *A. lumbricoides* are soil, humans, food (primarily raw fruit and vegetables) and water. It is generally transmitted, both directly and indirectly, through the ingestion of soil contaminated with human stool that harbors the worm's ova. Once the eggs(Fig. 4.12) enter the intestinal tract, they hatch into larvae that enter the blood stream and migrate to the capillaries of the lungs. There they mature for 10-15 days, crawl up the bronchia to the throat and are swallowed again. They then return to the small intestine where they become adults and lay more eggs. This process takes about 2-3 months.

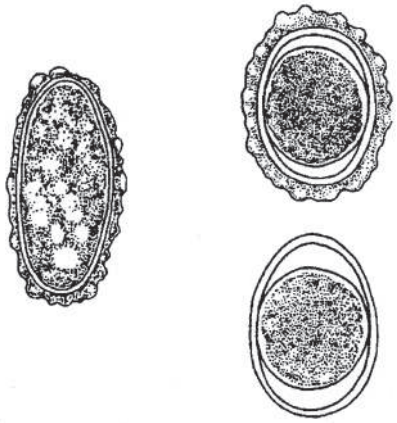

Fig. 4.12 Eggs of *Ascaris lumbricoides*

4.4.4.2.4 Symptoms

Ascariasisis is asymptomatic in a majority of cases. Signs and symptoms generally occur with heavier infections. After the larval migration to the lungs happens (early phase), symptoms associated with pneumonia may occur: persistent cough, shortness of breath, and wheezing. Intestinal infestation, the later phase, can cause the following signs and symptoms: vague abdominal pain, nausea and vomiting, and diarrhea and bloody stools.

Severe intestinal infestation is when the disease becomes dangerous and the

person may experience: severe abdominal pain, fatigue, vomiting, weight loss, malnutrition, worms emerging in stool or from mouth and nose.

4.4.4.2.5 Treatment and prevention

The disease is treated primarily by using anti-parasite medications of which the most common are mebendazole, albendazole and pyrantel. These drugs prevent infection by killing adult worms, larvae and eggs. Heavy infestation may require surgery, especially if there is intestinal, liver, or pancreatic obstruction or obstruction of the bile duct.

Prevention hinders mostly on the practice of good hygiene and sanitation since the disease is spread by ingesting contaminated soil. Those at risk should wash hands and potentially contaminated foods thoroughly. The use of human feces as fertilizer should also be discouraged.

4.5 Brief account of food spoilage

If food items are kept for a long period of time and not stored properly, they get spoil **(Fig. 4.13)** such food items are bad for health. When food items kept for a long time gets spoil as germs start growing on it. Once the food is spoiled, it cannot be eaten and has to be thrown away. Spoilage is a process in which food items deteriorate to the point in which it is not edible to human.

Fig. 4.13 Spoiled food

Food spoilage thus can be defined as a disagreeable change in a food's normal state. Such changes can be detected by smell, taste, touch, or sight. These changes are due to a number of reasons — air and oxygen, moisture, light, microbial growth, and temperature.

Food spoilage results when microbiological, chemical or physical changes occur, rendering the food product unacceptable to the consumer. Microbiological food spoilage is caused by the growth of microorganisms which produce enzymes that lead to objectionable by-products in the food. Chemical food spoilage occurs when different components in the food react with each other or with some added component which alter the food's sensory characteristics. Examples of this include: oxidation; enzymatic browning; and nonenzymatic browning. Physical food spoilage results when moist foods are excessively dehydrated or dried foods absorb excessive moisture. Examples of physical spoilage include water loss; increase in moisture of dry foods; freezer burn; and recrystallisation of frozen foods.

4.5.1 Causes of food Spoilage

The food and water may be infected by germs. Flies carry germs. When they sit on our food, they pass on these germs to our food. There are various factors which are responsible for food spoilage such as bacteria, mould, yeast, moisture, light, temperature, and chemical reaction.

4.5.1.1 Microbial spoilage

Microbial spoilage is caused by microorganisms like fungi (moulds, yeasts) and bacteria. They spoil food by growing in it and producing substances that change the colour, texture and odour of the food. Eventually the food will be unfit for human consumption.

When food is covered with a furry growth and becomes soft and smells bad, the spoilage is caused by the growth of moulds and yeasts (Fig.4.14). Microbial spoilage by moulds and yeasts includes souring of milk, growth of mould on bread and rotting of fruit and vegetables.

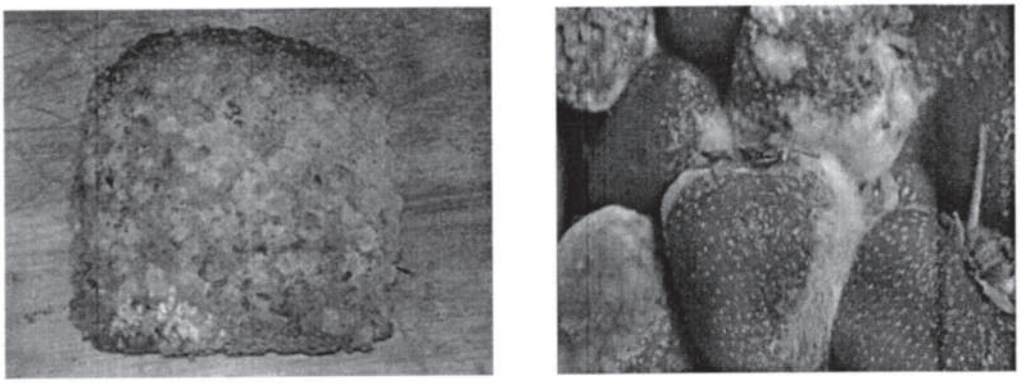

Fig.4.14 *Bread is too dry for bacterial growth, but fungi can grow very quickly*

These organisms are rarely harmful to humans, but bacterial contamination (Fig. 4.15) is often more dangerous because the food does not always look bad, even if it is severely infected. When microorganisms get access to food, they utilise the nutrients found in it and their numbers rapidly increase. They change the food's flavour and synthesise new compounds that can be harmful to humans. Food spoilage directly affects the colour, taste, odour and consistency or texture of food, and it may become dangerous to eat. The presence of a bad odour or smell coming from food is an indication that it may be unsafe. But remember that not all unsafe food smells bad.

Fig. 4.15 *Bacterial growth*

4.5.1.2 Physical spoilage

Physical spoilage is due to physical damage to food during harvesting, processing or distribution. The damage increases the chance of chemical or microbial spoilage and contamination because the protective outer layer of the food is bruised or broken and microorganisms can enter the foodstuff more easily. For example you may have noticed that when an apple skin is damaged, the apple rots more quickly.

4.5.1.3 Chemical spoilage

Chemical reactions in food are responsible for changes in the colour and flavour

of foods during processing and storage. Foods are of best quality when they are fresh, but after fruits and vegetables are harvested, or animals are slaughtered, chemical changes begin automatically within the foods and lead to deterioration in quality. Fats break down and become rancid (smell bad), and naturally-occurring enzymes promote major chemical changes in foods as they age.

4.5.1.3.1 Enzymic spoilage (autolysis)

Every living organism uses specialised proteins called enzymes to drive the chemical reactions in its cells. After death, enzymes playa role in the decomposition of once-living tissue, in a process called autolysis (self-destruction) or enzymic spoilage. For example, some enzymes in a tomato help it to ripen, but other enzymes cause it to decay **(Fig. 4.16)**.

Once enzymic spoilage is under way, it produces damage to the tomato skin, so moulds can begin to can attack it as well, speeding the process of decay.

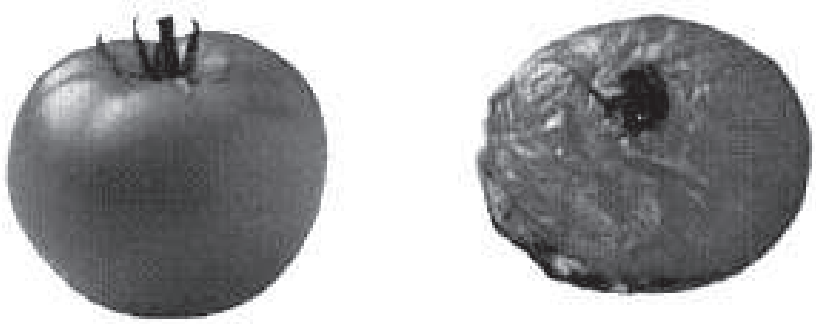

***Fig.* 4.16** *Role of enzymes in tomato spoilage: the tomato* on *the right has also been attacked by fungi [moulds], speeding its decay.*

4.5.1.3.2 Enzymic browning

When the cells of fruits and vegetables such as apples, potatoes, bananas and avocado are cut and exposed to the air, enzymes present in the cells bring about a chemical reaction in which colourless compounds are converted into brown-coloured compounds.

This is called enzymic browning. If the food is cooked very soon after cutting, the enzymes are destroyed by heat and the browning does not occur. For example, apples are prone to discolouration if cut open when raw, but when cooked they do not go brown.

4.5.2 Preventive measure of food spoilage

Food is valuable. Preserving food can help to avoid wasting of food. Food

preservation involves preventing the food from being spoilt. Food preservation is the process of treating and handling food to stop or slow down food spoilage, loss of quality, edibility, or nutritional value and thus allow for longer food storage. Preservation of food is the process by which food is stored by special methods.

Cooked or uncooked food can be preserved in different ways to be used later. Preservation usually involves preventing the growth of bacteria, fungi (such as yeasts), and other microorganisms, as well as retarding the oxidation of fats which cause rancidity.

4.5.2.1 Methods of Food Preservation

A number of methods of prevention can be used that can totally prevent, delay, or otherwise reduce food spoilage. Preservatives can expand the shelf life of food and can lengthen the time long enough for it to be harvested, processed, sold, and kept in the consumer's home for a reasonable length oftime.

Maintaining or creating nutritional value, texture and flavor is an important aspect of food preservation, although, historically, some methods drastically altered the character of the food being preserved. In many cases these changes have now come to be seen as desirable qualities, as with cheese, yogurt, and pickled onions.

Some methods of preservation are:

1. Freezing

Food kept in a refrigerator remains fresh for some days. Germs do not grow easily in cool places. We preserve food items, like milk, fruit, vegetables and cooked food by keeping them in a refrigerator.

Refrigeration preserves food by slowing down the growth and reproduction of microorganisms and the action of enzymes which cause food to rot. Freezing is also one of the most commonly used processes for preserving a very wide range of food including prepared foodstuffs which would not have required freezing in their unprepared state.

2. Boiling

By this method, we can preserve food for a short period of time. Germs in milk are killed by pasteurization. It is done by boiling milk for sometimes and then cooling it quickly.

3. Salting

We can add salt to preserve pickles and fish. Salting or curing draws moisture from the meat through a process of osmosis. Meat is cured with salt or sugar, or a combination of the two. Nitrates and nitrites are also often used to cure meat and contribute to the characteristic pink color, as well as inhibition of *Clostridium botulinum.*

4. Sweetening

Excess sugar in food also acts as a preservative. We store food for a long time in the form of jams, jellies, and murabbas by adding sugar. Sugar is used to preserve fruits, either in syrup with fruit such as apples, pears, peaches, apricots, plums, or in crystallized form where the preserved material is cooked in sugar to the point of crystallisation and the resultant product is then stored dry. This method is used for the skins of citrus fruit (candied peel), angelica, and ginger.

5. Dehydration

In this method, the food items are dried in sun to stop the growth of bacteria in them. Certain foods, like raw mangoes, fishes, potato chips and papads are preserved by this method. Drying is one of the most ancient food preservation techniques, which reduces water activity sufficiently to prevent bacterial growth.

6. Canning

In this method, air is removed from food and put in airtight cans so that germs do not grow on them. Food items like vegetables, seafood, dairy products etc. are preserved through this method. Canning involves cooking food, sealing it in sterile cans or jars, and boiling the containers to kill or weaken any remaining bacteria as a form of sterilization.

7. Vacuum-packing

Vacuum-packing stores food in a vacuum environment, usually in an air-tight bag or bottle. The vacuum environment strips bacteria of oxygen needed for survival, thereby slowing spoiling. Vacuum-packing is commonly used for storing nuts to reduce the loss of flavor from oxidation.

8. Pickling

Pickling (Fig. 4.17) is a method of preserving food in an edible anti-microbial liquid. Pickling can be broadly categorized into two categories: chemical pickling and fermentation pickling.

Fig. 4.17 *Pickling offood materials*

9. Chemical preservatives

These are anti-microbial substances. Certain additives are used to control the growth of undesirable bacteria, yeasts and moulds. Examples:

a) propionic acid used as a mould inhibitor in bread.

b) sulphur dioxide effective against bacteria, yeasts and moulds and used in dried fruits and peeled potatoes.

c) nitrates and nitrites used to cure meats to control *Clostridium botulinium.* Controlling one or more conditions required for the growth of micro- organisms slows the rate of food spoilage.

Foods have varying degrees of natural protection against spoilage and may require that the final step occur in a pressure cooker. High-acid fruits like strawberries require no preservatives to can and only a short boiling cycle, whereas marginal fruits such as tomatoes require longer boiling and addition of other acidic elements. Low acid foods, such as vegetables and meats require pressure canning. Food preserved by canning or bottling is at immediate risk of spoilage once the can or bottle has been opened.

4.5.2.2 Advantages and disadvantages

1. **Advantages of food preservation:** Germs do not grow easily in preserved food and make it safe to eat. Preservation enables us to enjoy seasonal fruits like strawberries and mangoes even during the offseason.

2. Disadvantages of food preservation: Excess salt and sugar are used in the preservation of food which is not good for health. Some methods of food preservation may lead to loss of nutrients.

4.6 Summary

I. Food hygiene is the conditions and measures necessary to ensure the safety of food from production to consumption.

II. Drinking water, also known as potable water or improved drinking water, is water that is safe to drink or to use for food preparation, without risk of health problems.

III. People earlier would store their water in earthen pots to keep the water clean and cold. People then moved on to filters and now it's the age of water purifiers.

IV. At domestic level, ceramic filters may be used. The essential part of a filter is ‘‘The candle”, made up of porcelain. Filter candles are able to remove bacterial, but not viruses.

V. Waterborne diseases are caused by drinking contaminated or dirty water. Contaminated water can cause many types of diarrheal diseases, including Cholera, and other serious illnesses such as Guinea worm disease, Typhoid, and Dysentery.

VI. Bacterial and viral infections have many things in common. Both types of infections are caused by microbes – bacteria and viruses, respectively – and spread by things such as:

a) Coughing and sneezing.

b) Contact with infected people, especially through kissing and sex.

c) Contact with contaminated surfaces, food, and water.

VII. Infections caused by protozoa can be spread through ingestion of cysts (the dormant life stage), sexual transmission, or through insect vectors. Protozoan infections can have a wide range of effects on the body depending on the type of single-celled parasite, or protozoa, involved. Protozoa that spread through unclean food or water usually affect the digestive system by living and multiplying in the intestines.

VIII. Parasites are living things that use other living things - like your body - for food and a place to live. You can get them from contaminated food or water, a bug bite, or sexual contact. Some parasitic diseases are easily treated and some are not.

IX. Food spoilage can be defined as: any changes in the visual, smell and texture of food that makes it unacceptable for consumption or is the process in which food deteriorates to the points it is not edible to humans or its quality of edibility becomes reduced.

X. Food spoilage can be the result of insect damage, physical injury, enzymatic degradation or microbial activity.

XI. The various methods of food preservation are

a) Refrigeration: a low temperature of the fridge does not allow germs to grow, thus food is preserved. Ex, vegetables, eggs and fruits.

b) Drying: Water is removed by heating or evaporation. Ex grain and pulses.

c) Pickling: Addition of salt and spices. Ex mango, lemon, vegetables.

d) Deep freezing: Keeping food, vegetables, meat and fish in the freezer for a long period.

e) Canning: Addition of sugar to make jam, jelly and sauces etc.

f) Airtight pouches: Keeping prepared food items in nitrogen or gas-filled poly pack pouches. Ex - chips, french fries, noodles etc.

Questions

1. What is meant by food hygiene?
2. Define potable water. Discuss various methods of water purification.
3. Write cause, symptoms, and mode of prevention of a bacterial infection studied by you.
4. Write cause, symptoms, and mode of prevention of any viral; infection studied by you.
5. Write cause, symptoms, and mode of prevention of a parasitic infection studied by you.
6. What is giardiasis? Name the causative agent and source of infection.
7. What is the cause of food spoilage?
8. How food spoilage can be prevented?

Notes