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UNIT I	**Nutrition and health – classification of foods –Balanced Diet – malnutrition - Nutritional deficiencies – Vitamin deficiencies. Nutritional Requirements of special groups.**

UNIT - I

NUTRITION

Nutrition may be defined as the science of food and its relationship to health. It is concerned primarily with the part played by *nutrients* in body growth, development and maintenance. The word *nutrient* or "food factor" is used for specific dietary constituents such as proteins, vitamins and minerals. *Dietetics* is the practical application of the principles of nutrition; it includes the planning of meals for the well and the sick. Good nutrition means "maintaining a nutritional status that enables us to grow well and enjoy good health".

Changing concepts

Through centuries, food has been recognized as important for human beings in health and disease. The history of man has been to a large extent struggle to obtain food. Until the turn of the 19th century the science of nutrition had a limited range. Protein, carbohydrate and fat had been recognized early in the 19th century as energy-yielding foods and much attention was paid to their metabolism and contribution to energy requirements. The discovery of vitamins at the turn of the 20th century "rediscovered" the science of nutrition. Between the two World Wars, research on protein gained momentum. By about 1950, all the vitamins and essential amino acids had been discovered. Nutrition gained recognition as a scientific discipline, with roots in physiology and biochemistry. In fact nutrition was regarded as a branch of physiology.

Great advances have been made during the past 50 years in knowledge of nutrition and in the practical application of that knowledge. Specific nutritional diseases were identified and technologies developed to control them, as for example, protein energy malnutrition, endemic goitre, nutritional anaemia, nutritional blindness and diarrhoeal diseases.

RELATION OF NUTRITION TO HEALTH

Good nutrition is a basic component of health. The relation of nutrition to health may be seen from the following view points:

(1) Growth and development : Good nutrition is essential for the attainment of normal growth and development. Not only physical growth and development, but also the intellectual development, learning and behaviour are affected by malnutrition. Malnutrition during pregnancy may affect the foetus resulting in still-birth, premature birth and "small-for dates" babies. Malnutrition during early childhood delays physical and mental growth; such children are slow in passing their "milestones", and are slow learners in school. Good nutrition is also essential in adult life for the maintenance of optimum health and efficiency. In short, nutrition affects human health from birth till death.

(2) Specific deficiency : Malnutrition is directly responsible for certain specific nutritional deficiency diseases. The commonly reported ones in India are kwashiorkor, marasmus, blindness due to vitamin A deficiency, anaemia, beriberi, goitre, etc. Good nutrition therefore is essential for the prevention of specific nutritional deficiency diseases and promotion of health.

(3) Resistance to infection : Malnutrition predisposes to infections like tuberculosis. It also influences the course and out-come of many a clinical disorder.

2. *Classification by chemical composition:*
   1) Proteins
   2) Fats
   3) Carbohydrates
   4) Vitamins
   5) Minerals
3. *Classification by predominant function:*
   1) *Body-building foods*, e.g., milk, meat, poultry, fish, eggs, pulses, groundnuts, etc.
   2) *Energy-giving foods*, e.g., cereals, sugars, roots and tubers, fats and oils.
   3) *Protective foods*, e.g., vegetables, fruits, milk.
4. *Classification by nutritive value:*
   1) Cereals and millets
   2) Pulses (legumes)
   3) Vegetables
   4) Nuts and oilseeds
   5) Fruits
   6) Animal foods
   7) Fats and oils
   8) Sugar and jaggery
   9) Condiments and spices
   10) Miscellaneous foods

NUTRIENTS

Nutrients are organic and inorganic complexes contained in food. There are about 50 different nutrients which are normally supplied through the foods we eat. Each nutrient has specific functions in the body. Most natural foods contain more than one nutrient. These may be divided into :

(i) *Macronutrients* : These are proteins, fats and carbohydrates which are often called "proximate principles" because they form the main bulk of food. In the Indian dietary, they contribute to the total energy intake in the following proportions:

Proteins	...	7 to 15 per cent
Fats	...	10 to 30 per cent
Carbohydrates	...	65 to 80 per

(ii) *Micronutrients* : These are vitamins and minerals. They are called micronutrients because they are required in small amounts which may vary from a fraction of a milligram to several grams.

A short review of basic facts about these nutrients is given below.

PROTEINS

The word "protein" means that which is of first importance. Indeed they are of the greatest importance in human nutrition. Proteins are composed of carbon, hydrogen, oxygen, nitrogen and sulphur in varying amounts. Some proteins also contain phosphorus and iron and occasionally other elements. Proteins differ from carbohydrate and fat in the respect that they contain nitrogen. Proteins are made up of simpler substances, called *amino acids*. These are the building blocks of protein.

Some 22 amino acids are stated to be needed by the human body, out of which eight are called "essential". The essential amino acids are: (1) Isoleucine (2) leucine (3) lysine (4) methionine (5) phenylalanine (6) threonine (7) tryptophane; and (8) valine. These are called "essential" because the body cannot synthesize them in sufficient quantity, and therefore they must be obtained from the food we eat.

Functions :

Proteins are needed by the body :-

(1) *For growth and development:* They furnish the building material; i.e. the

months to 3 years of age has been included in the CSSM programme.

Recommended allowances

The recommended daily intake of vitamin A is 600 micrograms for adults. The detailed recommendations are given in Table 7.

TABLE 7

Daily intake of vitamin A recommended by ICMR (1989)

Group	Retinol or (mcg)	β-carotene (mcg)
Adults		
Man	600	2400
Woman	600	2400
Pregnancy	600	2400
Lactation	950	3800
Infants		
0 to 12 months	350	1200
Children		
1 to 6 years	400	1600
7 to 12 years	600	2400
Adolescents		
13 to 19 years	600	2400

Source *(9)*

Toxicity

An excess intake of retinol causes nausea, vomiting, anorexia and sleep disorders followed by skin desquamation and then an enlarged liver and papillar oedema. High intakes of carotene may colour plasma and skin, but do not appear to be dangerous *(25, 34)*. The teratogenic effects of massive doses of vitamin A is the most recent focus of interest *(35)*.

VITAMIN D

The nutritionally important forms of Vitamin D in man are Calceferol (Vitamin D_2) and Cholecalciferol (Vitamin D_3). Calciferol may be derived by irradiation of the plant sterol, ergosterol. Cholecalciferol is the naturally occurring (preformed) vitamin D which is found in animal fats and fish liver oils. It is also derived from exposure to UV rays of the sunlight which convert the cholesterol in the skin to vitamin D. Vitamin D is stored largely in the fat depots.

Vitamin D : Kidney hormone

Major advances have been made in recent years in our understanding of the metabolism of vitamin D in the body *(36)*. It is now known that vitamin D, by itself, is metabolically inactive unless it undergoes endogenous transformation into several active metabolites (e.g., 25, HCC; 1 :25 DHCC) first in the liver and later in the kidney. These metabolites are bound to specific transport proteins and are carried to the target tissues – bone and intestine. It has been proposed that vitamin D should be regarded as a kidney hormone *(38)* because it does not meet the classic definition of a vitamin, that is, a substance which must be obtained by dietary means because of a lack of capacity in the human body to synthesize it. In fact, vitamin D_3 is not a dietary requirement at all in conditions of adequate sunlight. It can be synthesized in the body in adequate amounts by simple exposure to sunlight even for 5 minutes per day.

Functions

The functions of vitamin D are summarised in Table 8.

TABLE 8

Functions of vitamin D and its metabolites

Intestine :	Promotes intestinal absorption of calcium and phosphorus
Bone :	Stimulates normal mineralization Enhances bone resorption Affects collagen maturation
Kidney :	Increases tubular reabsorption of phosphate Variable effect on reabsorption of calcium
Other :	Permits normal growth

Source *(37)*.

Sources

Vitamin D is unique because it is derived both form sunlight and foods. (a) **Sunlight** : Vitamin D is synthesized by the body by the action of UV rays of sunlight on 7-dehydrocholesterol, which is stored in large abundance in the skin. Exposure to UV rays is critical; these can be filtered off by air pollution. Dark-skinned races such as Negroes also suffer from this disadvantage because black skin can filter off up to 95 per cent of UV rays. (b) **Foods** : Vitamin D occurs only in foods of animal origin. Liver, egg yolk, butter and cheese and some species of fish contain useful amounts. Fish liver oils, although not considered to be a food, are the richest source of vitamin D. Human milk has recently been shown to contain considerable amounts of water-soluble vitamin D sulfate *(37)*. Other sources of vitamin D are foods artificially fortified with vitamin D, such as milk, margarine, vanaspathi and infant foods. Dietary sources of vitamin D are given in Table 9.

TABLE 9

Dietary sources of vitamin D

	μg/per 100g		μg/per 100g
Butter	0.5–1.5	Shark liver oil	30–100
Eggs	1.25–1.5	Cod liver Oil	200–750
Milk, whole	0.1	Halibut liver oil	500–10,000
Fish fat	5–30		

Deficiency

(1) Rickets : Vitamin D deficiency leads to *rickets*, which is usually observed in young children between the age of six months and two years. There is reduced calcification of growing bones. The disease is characterised by growth failure, bone deformity, muscular hypotonia, tetany and convulsions due to hypo-calcemia. There is an elevated concentration of alkaline phosphate in the serum. The bony deformities include curved legs, deformed pelvis, pigeon chest, Harrison's sulcus, rickety rosary, kyphoscoliosis, etc. The milestones of development such as walking and teething are delayed. (2) Osteomalacia : In adults, vitamin D deficiency may result in *osteomalacia* which occurs mainly in women, especially during pregnancy and lactation when requirements of vitamin D are increased.

Both rickets and osteomalacia are frequently reported in India, although they do not appear to be a problem of public health importance. In the world as a whole, their prevalence has declined as a result of changes in social customs (e.g., purdah system), and the expansion of mother and child health services leading to better care and feeding of infants and children *(3)*. In the developing countries today, rickets as a menace to child health is overshadowed by the prevalence of protein energy malnutrition.

VITAMIN E

Vitamin E (tocopherol) is widely distributed in foods. It is available in small quantities in meats, fruits and vegetables. By far the richest sources are vegetable oils (e.g. oils of sunflower seeds, cotton seeds, safflower seeds). Since vitamin E is available in many foods, humans on balanced diet do not easily suffer from its deficiency. In fact, the role of vitamin E in human nutrition has not so far been established. The usual plasma level of vitamin E in adults is between 0.8 and 1.4 mg per 100 ml. While there is no doubt that man requires tocopherol in his diet, there is no clear indication of dietary deficiency. The role of vitamin E at the molecular level is little understood. The

current estimate of vitamin E requirement is about 0.8 mg/g of essential fatty acids. However, in animals, deficiency of vitamin E is associated with habitual abortion, testicular and myocardial degeneration.

VITAMIN K

Vitamin K occurs in (1) fresh green vegetables and (2) fruits. It is also synthesised to some extent by intestinal bacteria. This vitamin is necessary for proper clotting of blood. It is used therefore, for the prevention and treatment of bleeding. Vitamin K is also given to patients if they are known to suffer from defects of absorption due to lack of bile salts or other types of malabsorption. Deficiency of vitamin K rarely occurs in adults who consume normal balanced diets.

The vitamin K requirement of man is met by a combination of dietary intake and microbial synthesis in the gut. The daily requirement for man appears to be about 0.03 mg/kg of body weight for the adult. Newborn infants tend to be deficient in vitamin K due to minimal stores of prothrombin at birth and lack of an established intestinal flora. Soon after birth, all infant or those at increased risk should receive a single intramuscular dose of a vitamin K preparation (0.1-0.2 mg of menadione sodium bisulfite or 0.5 mg of vitamin K) by way of prophylaxis.

THIAMINE

Thiamine or vitamin B_1 is a water-soluble vitamin. It is an important member of the B-group of vitamins. It is relatively stable to heat, but is destroyed in neutral or alkaline solution.

Functions:

(1) Thiamine plays an important part in carbohydrate metabolism. In thiamine deficiency, there is accumulation of pyruvic and lactic acids in the tissues and body fluids.

(2) Thiamine is also essential for the proper functioning of the nervous system.

Sources:

Thiamine is widely distributed in small amounts in all natural foods. The richest sources are unmilled cereals, pulses and nuts especially groundnut. The main source of thiamine in the diet of Indian people is cereals (e.g., wheat, rice, which contribute from 60 to 85 per cent of the total supply). Meat, fish, eggs, vegetables and fruits are relatively poor in vitamin B_1.

TABLE 6
Thiamine in foodstuffs

Food	mg per 100 grams
Wheat whole	0.54
Rice, raw homepounded	0.21
Rice, milled	0.06
Bengal gram dhal	0.48
Almonds	0.24
Gingelly Seeds	1.01
Groundnut	0.90
Milk, whole	0.05
Egg, hen's	0.13
Liver	0.36

Losses:

Thiamine is readily lost from cereals during the process of washing and cooking. The milling of rice results in considerable loss of thiamine. On the other hand, parboiled and homepounded rice are better sources. Thiamine in fruits and vegetables is partly lost during prolonged storage.

Daily requirement:

Daily requirement of thiamine is 0.5 mg per 1000 kcals of energy intake. The body content of thiamine is placed at 30

in the tropics, and also among pregnant women. There is a national programme in India, under which anaemia among pregnant women and young children is being combated through the supply of iron and folic acid tablets (folifer tablets). **Requirement:** The daily requirement for healthy adults is 100 micrograms (µg.); and during pregnancy 400 µg. Children need 100 µg.

VITAMIN B_{12}

Like folic acid, vitamin B_{12} is also necessary for the synthesis of DNA. In addition, this vitamin is also required in carbohydrate, fat and protein metabolism. **Sources:** Liver, eggs, fish and milk contain vitamin B_{12}. Foods of vegetable origin do not contain this vitamin. Therefore B_{12} deficiency is seen in diets of strict vegetarians who do not even take milk. Although synthesized by intestinal bacteria, that which is synthesized is not available to the body. **Deficiency:** Deficiency of vitamin B_{12} leads to pernicious anaemia, a disease characterised by marked decrease in the number of red blood cells. B_{12} deficiency can also affect the nervous system, including the spinal cord. B_{12} deficiency is to some extent linked with the deficiency of another vitamin, viz folic acid. **Requirement:** The daily requirement is very small – about 1 microgram for adults. For proper utilization of vitamin B_{12} gastric secretion should be normal.

VITAMIN C

Vitamin C or ascorbic acid is a water soluble vitamin. It is the most unstable of all the vitamins; gets rapidly destroyed by high temperature, oxidation, drying or storage.

Functions :

Vitamin C is required for a variety of roles in life processes: (1) It is required to form collagen, the protein substance that binds the cells together. If this substance is not formed, healing of the wounds will be delayed (2) bleeding phenomena appear on vitamin C deficiency (3) helps in increasing the absorption of iron (4) helps in increasing the general resistance of the body to fight infection.

Sources:

(1) *Fruits :* All fresh fruits contain vitamin C. Amla or the Indian gooseberry is one of the richest sources, in the fresh as well as in the dry condition. Guavas are another cheap but rich source. (2) *Vegetables* : Vegetables especially green leafy vegetables are rich in vitamin C. Roots and tubers (potatoes) contain very small amounts. Sprouting pulses are yet another source. (3) *Animal foods :* Meat and milk contain very small amounts.

TABLE 7
Dietary Sources of Vitamin C

	mg per 100 g		
Fruits :		*Vegetables :*	
Amla	600	Amaranth	99
Guava	212	Cabbage	124
Lime	83	Spinach	28
Orange	30	Brinjal	12
Tomato	27	Cauliflower	56
Germinated Pulses :		Potatoes	17
Bengal gram	15	Onion	11
Green gram	16	Raddish	15

Deficiency :

Deficiency of vitamin C results in a bleeding disease called scurvy. Scurvy is seen in infants fed on deficient artificial feeds. Scars of previous wounds may break down and become open wounds again in severe cases of scurvy. Minor

customs, situations and behaviour.

BALANCED DIET

We have considered so far the nutritional requirements of the body, including calories. The question that arises now is how to formulate a balanced diet. A balanced diet is defined as one which provides: (1) a sufficient number of calories (2) adequate amounts of protein, fat and carbohydrate (3) an adequate amount of vitamins and minerals for maintaining health, vitality and general

handlers: (a) *Hands*: The hands should be clean at all times. Hands should be scrubbed and washed with soap and water immediately after visiting a lavatory. Finger nails should be kept trimmed and free from dirt. (b) *Hair* : Head covering should be provided, particularly in the case of females to prevent loose hairs falling into food (c) *Overalls*: Clean white overalls or aprons should be worn by all food handlers. (d) *Habits* : Coughing and sneezing in the vicinity of food, licking the fingers before picking up an article of food, smoking on food premises are to be avoided.

Food-Borne Diseases

Food-borne infections and diseases may be classified as below :-

(1)	*Bacterial*	:	Typhoid and paratyphoid Diarrhoea Dysentery
(2)	*Viral*	:	Viral hepatitis (jaundice), Poliomyelitis
(3)	*Protozoal*	:	Amoebiasis
(4)	*Intestinal*	:	Tape worm and round worm
(5)	*Others*	:	Food poisoning

MALNUTRITION

Malnutrition is a condition which occurs when the body does not get the proper kind of food in the amounts needed for maintaining health. Malnutrition can occur at any age, but most frequently it occurs in children. The largest number of malnourished children are between 6 months and 3 years of age.

Signs and Symptoms :

The signs and symptoms of malnutrition in children are :

(1) growth failure i.e: the child loses weight
(2) oedema
(3) anaemia
(4) skin changes-skin dry, scaly or rough: loss of subcutaneous fat (elasticity)
(5) eye changes-dryness of eye, nightblindness
(6) hair changes – light colour, brittle
(7) others – apathy, listlessness, soreness of mouth, bowing of legs, frequent episodes of illness, etc.

Screening for malnutrition :

There are several techniques for identification of malnourished children: (1) **Height and Weight :** The best way to identify children who are malnourished is to take their height and weight regularly – once a month in the case of children, and at 3 to 6 months intervals in the case of older children. The growth chart or Road-to-health chart (see Chapter 13) offers a simple and inexpensive means of monitoring child health and nutritional status. (2) **Midarm Circumference:** Another simple and useful technique is to measure the mid-arm circumference. Any child between 1 to 5 years is considered to be malnourished, if the measurement is less than 12.8 cms. (3) **Clinical and Laboratory Examination:** An examination of the child from head to foot for signs of malnutrition (e.g. protein, vitamin and mineral deficiencies) is another approach for detecting malnutrition. Such examinations may be supplemented by laboratory tests such as estimation of haemoglobin.

Problems of Malnutrition :

(1) **Kwashiorkor and marasmus:** These are serious diseases of protein energy malnutrition, which develop in young children between 1-3 years of age. They are due to (a) an inadequate diet, that is, a diet lacking in proteins and calories, and (b) infections such as diarrhoeas, measles, bronchitis, which lead the child into malnutrition. The outstanding features of **kwashiorkor** are: oedema, growth failure, diarrhoea, hair and skin changes. The

Weaning Period :

Weaning is not sudden withdrawal of child form the breast. It is a gradual process starting around the age of 6 months, because the mother's milk alone is not sufficient to sustain the growth beyond 4 to 6 months. It should be supplemented by suitable foods rich in protein and other nutrients. These are called "supplementary foods". These are usually cow's milk, fruit juice, soft cooked rice and vegetables. If the child is malnourished during the weaning period, which is a most crucial period in child development, he is liable to protein-energy malnutrition (e.g., kwashiorkor and marasmus). Nutritional supplements can be easily prepared at home using low-cost, locally available foods such as cereals, millets, pulses, groundnuts, sugar or and fruits.

PRE-SCHOOL CHILDREN :

Children in the age group 1 to 5 years merit special attention. They show a good deal of physical activity and growth. Therefore, they need extra protein, vitamins and minerals.

The energy requirements of a child aged 1 year is about 1,000 kcals daily. After the age of 1 year, the energy needs may be calculated by adding 100 kcals for every year of life (Table 21).

Children between the ages 1 to 5 years are often neglected and underfed by their mothers. This is because mothers do not know that these children need more food for their size than adults. In many poor families, young children are breast-fed until they are 2 to 3 years and are not