UNIT
1

# Concepts of Health and Disease

## INTRODUCTION

Health is considered as the fundamental human right of any person and is a worldwide social goal. The aim of the Government of any nation is to improve the health of the people through high-quality healthcare services that are equally accessible to all at affordable prices. *'Health is wealth'* is taught to us since childhood. Thus, health is of concern to every individual, community, state and nation. Now health has attained global status and relies on continuous advancement in the field of medicine and public health.

The concept of health varies widely. Pharmacists as well as members of healthcare team are much more actively concerned with the concept of health. In 1977, the World Health Assembly committed that the main social target of governments and WHO (World Health Organization) in the coming decades would be 'the attainment by all citizens of the world by the year 2000 of a level of health that will permit them to lead a socially and economically productive life'. Thus *'Health for All by 2000 AD'* was adopted as internationally attainable target. It was not merely a slogan but recognition of the importance of health in national and international perspective. *'Health for All'* means that health must be within the reach of everyone. It suggests the elimination of major obstacles like malnutrition, contaminated water supply, unhygienic living condition and diseases, etc. that are major obstacles to health. Unfortunately, India failed in attaining this objective. In 1979, the United Nations adopted health as an essential part of socioeconomic development.

Health has been defined in various ways and hence there exist a number of definitions. However, a perfect definition is still not settled mainly because different people view it in different perspectives.

According to WHO, '*Health is a state of complete physical, mental and social well-being and not merely an absence of disease or infirmity'.*

This is an old definition, which has been appraised as being too broad and idealistic. According to this definition all of us are sick and nobody is healthy. During the last few decades, the WHO definition of health has been gradually revised and supplemented by the fourth dimension-spiritual health.

According to the Oxford English Dictionary *'health is soundness of body or mind, that condition in which its functions are duly and effectively discharged'.*

Webster dictionary definition *'health is the condition of being sound in body, mind or spirit, especially freedom from physical disease and pain'.*

According to the **modern philosophy '***health is a fundamental right without any distinction of race, religion, political belief, economic or social condition. It is the essence of productive life and integral part of development. It is a worldwide goal and involves individual, national and international responsibility'.*

## CONCEPTS OF HEALTH

Health has evolved as a concept over centuries from an individual concern to a global social goal. The concept of health is dynamic. As all other concepts change and the newer concepts emerge, the concept of health also keeps on changing. The members of a community including professional groups like health administrators, scientists, ecologists, politicians, etc. perceive it in different ways. This obviously leads to confusion and we come across different concepts of health. These concepts include the definitions of a health norm and a systematic way of identifying and dealing with the deviations. **Disease** is considered as a deviation from normal health. Important concepts of health are discussed below.

### A. Biomedical Concept

This concept is based on the **germ theory of disease**. The medical profession considers the human body as a machine, disease as a result of the breakdown of the machine, and one of the doctor's tasks being to repair the machine. However, the biomedical concept is found inadequate to solve major health problems like accidents, chronic diseases, malnutrition, mental illness, population explosion, drug abuse, environmental pollution, etc.

### B. Ecological Concept

The ecologists considered health as a dynamic equilibrium between man and the environment and disease as maladjustment of the human organism to environment. According to Dubos 'health implies the relative absence of pain and discomfort and a continuous adaptation and adjustment to ensure optimal function'. We must appreciate that human ecological and cultural adaptations do determine the occurrence of diseases as well as the availability of food and population explosion. It is believed that greater human acclimatization to environments can result in longer life expectancies and a healthier life even in the absence of modern healthcare services. Recently, there has been an increasing recognition for 'environmental friendly' products including pharmaceutical and specially packaging materials.

### C. Psychological Concept

According to this concept health is both a biological as well as social phenomenon because it is influenced by psychological, social, cultural and political factors. Psychological and social considerations are very important in the concept of health.

### D. Holistic Concept

Holistic means encompassing the whole of a thing, and not just the part. *Holistic* medicine looks at the whole person for answers, not just at physical symptoms. Holistic concept of health represents the combination of all the above concepts. It takes into account all the factors like social, economic, political and environmental. This concept is defined as a unified and multidimensional process involving the well-being of the person in the context of his environment. It indicates that all sectors of society, e.g. animal husbandry, agriculture, food, industry, public works, education, communication, etc. have an influence on health. The holistic concept is mainly concerned with the protection and promotion of public health.

The preference for different theories varies by social and demographic characteristics, such as education, occupation, income and ethnic group membership. As members of healthcare team and experts on drugs, pharmacists can play an important role in clarifying for the consumer/patients the points on which folk or coexistent therapies may be in conflict with scientific procedure.

## MODELS FOR HEALTH DESCRIPTION

A model is a hypothetical method of understanding an idea or concept. It characterizes different ways of handling complex issues. Health beliefs, i.e. person's ideas, opinions, and attitudes about health and disease generally influence health behavior which in turn affect person's health either positively or negatively. '*Prevention of disease is better than cure*' is a positive health belief. Some common positive health behaviors include immunisation, proper nutrition, proper sleep, and adequate level of exercise and good nutrition. Preventing illness is important aspect of healthcare that focuses on detection or prevention of disease. Important models used to describe health are explained below:

1. **Clinical model**
    a. Good health is indicated by the absence of signs and symptoms of disease.
    b. Illness is the presence of conspicuous signs and symptoms of disease.
    c. People who follow this health model to guide their use of healthcare services generally do not seek preventive health services or they wait until they are very ill to seek care.
2. **Role performance model**
    a. An important component of the role performance model is the sick role, in which individuals are exempted from performing their social roles during sickness.
    b. Health is indicated by their ability to perform social roles.
    c. Role performance includes work, family and social roles.
    d. Illness would be the failure to perform a person's roles at the level of others in society.
    e. This model is the basis for work and physical examination by a physician.
3. **Adaptive model**
    a. Health is indicated by the ability of the person to adapt positively to social, mental, and physiological change.
    b. Illness occurs when a person fails to adapt toward these changes.
4. **Agent-host-environmental model**
    a. This model was postulated by Leavell and Clark in 1965.
    b. It is useful for investigating causes of disease in a person.
    c. The agent, host and environment interact in many ways and create various risk factors. It is very important to understand these factors for the promotion and maintenance of health.

d. An illness is caused by the presence or absence of an agent (environmental factor or stressor).
e. A host is a living organism infected or affected by an agent.
f. The host reaction is influenced by age, family history, and health habits.

5. **High level wellness model**
   a. It was proposed by Dunn in 1961.
   b. It considers health as an ongoing process toward a person's highest potential of functioning. This process involves the person, family and the community.
   c. It describes the high-level wellness as 'the experience of a person alive with the glow of good health, alive to the tips of their fingers with energy to burn, tingling with vitality—at times like this world is a glorious place'.
6. **Holistic health model**
   a. It was proposed by Edelman and Mandle in 2002.
   b. Holism recognizes the interaction of a person's mind, body and spirit within the environment. Holism is an antidote to the atomistic approach of contemporary science. An atomistic approach takes things apart, examining the person piece by piece in an attempt to understand the larger picture.
   c. Holism is based on the belief that people cannot be fully understood if examined solely in pieces apart from their environment.
7. **Nightingale's theory of environment**
   a. It was postulated by Florence Nightingale.
   b. This model considers health as a constantly changing state, with high level wellness and death being on opposite ends of a graduated scale, or continuum.
   c. This continuum illustrates the dynamic state of health, as a person adapt to changes in the internal and external environments to maintain a state of well-being. A patient with chronic illness may view himself/herself at different points of the continuum at any given time, depending on how well the patient believes he/she is functioning with.

## Dimensions of Health

Health is **multidimensional;** important dimensions being physical, mental, social and spiritual. Other dimensions could be emotional, vocational, political, etc. Each dimension functions and interacts

with each other but has certain characteristics. These dimensions of health are explained below:

A. **Physical dimension:** It is easiest to understand physical dimension of health. It represents the health as a state of fitness in which the functioning of every cell and every organ of the body is optimum and is in perfect harmony with the rest of the body. Thus, physical health implies absence of an obvious disease.

   It is characterized by normal functioning of the body organs, e.g. normal blood pressure, normal liver functioning, normal skin and so on. A *nomogram* correlating the average height with average weight could be used as an indicator of physical health. It should be remembered that physical health is assessed in terms of age and sex of an individual by comparing, e.g. the vital capacity of his/her lung with the reported normal value for that age and sex.

B. **Mental dimension:** Mental health is defined as a state of balance between the individual and the surrounding world, a state of harmony between oneself and others, a coexistence between the realities of self and that of other people, and that of environment. Mental health is difficult to assess. It is certainly not mere absence of mental disease but is the ability of the person to respond to the experiences of life with flexibility and is influenced by psychological factors. Schizophrenia and depression are examples of mental illness. Mental illness can also lead to physical illness, e.g. mental tension may lead to peptic ulcer. Similarly, physical illness can also lead to mental illness, e.g. a leprotic person may suffer from depression. Exact assessment of mental health is difficult but approximate comparisons are possible by assessing the mental functioning. Positive mental health is one of the keys to good health and indicates that the person is free from undue conflicts and has harmonious relationship with family and community.

C. **Social dimension:** Social health is defined as the quantity and quality of an individual's interpersonal ties and the extent of involvement with the community. It recognizes the fact that every individual is part of the society and takes into consideration the socioeconomic status and health of the 'whole person' in the context of his social network. Social health involves harmony and integration with the individual, between each individual and other members of society, and between individuals and the world that he lives in.

D. **Spiritual dimension:** Spiritual dimension of health includes integrity, principles and ethics, purpose in life, commitment to some higher being and belief in concepts that are not subject to the 'state-of-art' explanation. It is linked to that part of the person, which reaches out and strives for meaning and purpose in life. It is related to the 'spirit', the sole. All religions and religious leaders consider the attainment of spiritual health as the ultimate goal of life.
E. **Emotional dimension:** Emotional health refers to 'feeling'. A person is said to be emotionally healthy when he does not loose temper or does not develop tension and maintains self-control.
F. **Vocational dimension:** It is a part of the human existence. A person is said to be healthy vocationally, when he/she is able to earn sufficiently to lead a successful life. Goal achievement and self-realization in work are source of life success and increased self-esteem.

In addition to the above, health could also be defined in terms of many other dimensions, such as nutritional, socioeconomic, educational, curative, preventive environmental, etc. The WHO definition of health as 'a state of complete physical, mental and social well-being and not merely an absence of disease' is certainly very broad and covers most of the dimensions of health, directly or indirectly.

## DETERMINANTS OF HEALTH

Health of an individual is not static; it is a dynamic phenomenon and a process of continuous change. It is a state, which is to be attained first and then maintained. Health fluctuates within a range of optimum well-being to various levels of deficiencies including death. Disease may manifest itself at any time of life.

Factors, which either alone or in combination are responsible for diseases, include genetics, infective organisms, nutritional deficiencies, metabolic disturbances, allergic disorders, ageing and degenerative processes, cancer and other neoplasm, iatrogenesis, accidental injuries and social pathology. The health of individuals and communities may be considered as the result of interactions due to genetic and environmental factors.

Important determinants of healthare described below:

### A. Heredity

Besides other factors, health is also dependent on the genetic makeup of an individual. These inborn actors play a part in determining

lifespan and likelihood of developing certain illnesses. In this context health is defined as 'that state of the individual, which is based upon the absence from the genetic constitution of genes that cause serious defect or the presence in the genetic constitution of the genes, which correspond to the normal characterization'. It is the nature of genes at the time of conception, which governs the characteristics of an individual. This is the reason why most of the genetic diseases are difficult to cure. Common diseases of genetic origin are mental retardation, errors of metabolism and chromosomal anomalies. Currently scientists all over the world are attempting to synthesize genes, which are best in every respect including health as genetic heritage.

### B. Environment

A pharmacist knows very well that environment directly affects the physical, mental and social health of the person. The physical, biological and social components of environment are linked with one another and collectively influence the health status of people. Person's physical and mental capabilities can be realized only in a favorable environment. The whole world is seriously concerned with the promotion and protection of family and environmental health. Clean environment is absolutely essential for good health. Main determinants of physical environment include a varying range of factors like environmental sanitation, soil condition, forests, atmospheric pollution, and rainfall, etc. The socioeconomic status, traditions, relationship, customs and superstitions of people are important social aspects of environment. Biological environment comprises disease causing plants and animals including bacteria, viruses, parasites, arthropods and pathogens. Environment is classified as internal, external, and domestic environment.

The internal environment is concerned with each and every element, every tissue, every organ, and organ system and their harmonious functioning within the system.

The ***external environment*** *or* ***macroenvironment*** pertains to everything that is external to the person and includes the things to which person is exposed after conception.

***Microenvironment*** *or* ***domestic environment*** is the personal environment pertaining to the person's way of living and lifestyle, e.g. personal habits, smoking or drinking, exercise, etc. All the above types of environment can influence the health status of the people.

### C. Lifestyle

Lifestyle basically reflects the social values, activities, and attitudes of people. It is comprised of cultural and behavioral patterns and life-long personal habits like smoking and drinking. It plays an important role in the presentation of health status of people. Thus, health can be viewed as the quality of lifestyle that enables the individual to live most and serve best. Habit is called second nature. Habits are largely responsible for determining one's lifestyle. Lifestyles are learnt through social interaction, school and mass media. Healthy lifestyles would include adequate nutrition, sufficient sleep, enough physical activity, etc. Negative lifestyle including smoking, alcoholism and certain 'drugs', are not conducive to health.

### D. Socioeconomic Conditions

Socioeconomic conditions like education, economic status, political system, employment, housing, etc. have a great deal of influence on the human health. These factors are multiple, interactive and frequently go beyond the control of person. Integrated and multi-levels of public health interventions are vital to shape these factors for a positive health impact. Educated people better appreciate the importance of health. Health status improves with level of education. Education is closely tied to socioeconomic status. It increases job opportunities and income security, improves peoples' ability to access and understand health related information to stay healthy. Education improves the overall human attitude to health. Low mortality rate in Kerala is partly due to high literacy rate. The economic status as indicated by per capita GNP also influences the health status. Higher income and better economic status mostly result in more control and discretion. Income determines living conditions such as safe housing and ability to buy sufficient good quality food. This way better economic status can be responsible for increased life expectancy, reduced mortality rate, and improved quality of life. WHO recommends the expenditure of at least 5% out of GNP of a country on healthcare. This is possible only if the political system in the country is committed to provide improved healthcare by framing and implementing prior policies and by allocating necessary funds. Unless the political leaders make serious efforts, the health development would be difficult. It is equally important to realize that factors like housing, sanitation, nutrition, employment, etc. also contribute in the overall socioeconomic conditions.

### E. Health and Family Welfare Services

Effective health services improve healthcare and health. The extent to which health services are provided is directly reflected in terms of life expectancy and various mortality rates. Health services should be available at reasonable cost and equally to all individuals starting from pregnant women, infants, adults, males and females, cancer patients, mentally retarded people, etc. In India the Ministry of Health and Family Welfare is responsible for planning and implementing health services. Primary Health Centers (PHCs) at village level, family welfare schemes, hospitals, etc. help in improving health services.

### F. Other Factors

Health is a resultant of so many factors including the primary factors discussed above. In addition, there are other factors outside the formal healthcare system such as rural development, social welfare, food and agriculture, industry, economic and social policies, which should assist in improving the standard of living and ultimately the health status of individuals, the society, the nation and the world. Pharmacist is a part of healthcare team as one who is expert on drugs and related matters.

People's health is influenced by numerous factors, which go beyond the healthcare sector. Therefore, community contribution and intersectoral cooperation are essential to integrate and transform health promotion actions and health determinants for the better. The healthy cities project provides an excellent platform to enable combined strenuous effort of all sectors of the community to improve health in the place where we live and work.

## HEALTH INDICATORS FOR EVALUATION OF PUBLIC HEALTH

Health indicators are used to assess the health status of a specific population, e.g. a community, district, state, country, and compare it with other community, district, state or country. According to WHO 'indicators are variables, which help to measure changes'. Indicators are expressed as rates for a particular base over a definite period of time. The general formula for a rate of any type is:

$$\text{Rate} = \frac{\text{No. of events measured}}{\text{Population at risk}} \times \text{K}$$

where K is a constant and multiple of time.

Such indicators are helpful in monitoring and evaluation of healthcare services, healthcare activities and health programs. They can also assess the success or failure of any health program.

## Groups of Health Indicators

Ideal indicators of health should be *valid, reliable, sensitive* and *specific*. Main groups of health indicators are discussed below:

### *a. Mortality indicators*

Mortality represents expectancy of life at various ages, etc. Obviously, it takes into consideration the number of deaths out of a definite population. Mortality indicators represent the traditional measures of health status. The rate can be calculated for any age or sex group or both, in an area, during a year. Common mortality indicators are calculated as follows:

i. $$\text{Crude death rate} = \frac{\text{No. of deaths during the year}}{\text{Mid-year population}} \times 1000$$

ii. $$\text{Age and sex specific death rate} = \frac{\text{No. of deaths registered or estimated in an age and sex group during a year in an area}}{\text{Estimated population of that age and sex group for the year in that area}} \times K$$

iii. $$\text{Infant mortality rate} = \frac{\text{No. of deaths registered or estimated of children below one year of age during a year in area}}{\text{No. of live births registered or estimated during the year in the area}} \times 1000$$

iv. Maternal mortality rate: It accounts for deaths during antenatal, natal and postnatal.

v. $$\text{Child mortality rate} = \frac{\text{No. of deaths registered or estimated of children between one to four years of age during a year in area}}{\text{Mid-year population of one to four years of age group}} \times 1000$$

### *b. Morbidity indicators*

Morbidity means any departure from a state of well-being due to a disease, an injury or any impairment. Morbidity indicators supplement the mortality data to describe the health status of a population. They are designed to measure the occurrence of diseases, injuries, and disabilities in populations. Commonly used morbidity indicators are explained below:

i. **Incidence rate:** Rate of incidence of any disease either for the number of persons or spells of sickness can be calculated as:

$$\text{Incidence rate} = \frac{\text{No. of cases of sickness starting during the period in an area}}{\text{Average no. of persons exposed to risk during that period in that area}} \times 1000$$

ii. **Prevalence rate:** It measures the extent of total prevalence of a disease during a period (whether starting before or during that period). **Point prevalence rate** gives the rate at a point of time, whereas **period prevalence rate** gives the rate for a period of time. It is calculated as:

$$\text{Period prevalence rate} = \frac{\text{No. of cases of a disease prevalent at any point (or period) in the area}}{\text{Average no. of persons exposed to the risk during that point (or period) of time}} \times 1000$$

iii. **Case fatality rate:** It measures the extent of fatality of any disease, e.g. the proportion of deaths from a disease to the reported cases of that disease.

$$\text{Case fatality rate} = \frac{\text{No. of people who die of a disease}}{\text{No. of people who have the disease}} \times K$$

### *c. Disability rates*

It represents the percentage of the population unable to perform the expected daily routine activities like walking, eating, dressing due to injury or illness (e.g. cerebral palsy, paralysis, poliomyelitis, blindness, Down syndrome and depression) and personal and

environmental factors (e.g. inaccessible transportation, negative attitudes, and limited social supports).

i. **Sullivan's index:** It is the most advanced indicator based on the expectation of life, free of disability. It is calculated as:

Sullivan's index = Life expectancy (years) – duration of bed disability and inability (years) to perform major activities

Thus, if the life expectancy is 60 years and bed disability and inability to perform major activities is 5 years, then Sullivan's index would be 60–5 = 55 years.

ii. **Health adjusted life expectancy (HALE):** HALE, previously known as disability adjusted life expectancy (DALE), is based on life expectancy at birth yet, includes an adjustment for life period spent in the state of poor health. It can be defined as the number of years a newborn is expected to live in full health based on current rates of ill-health and mortality.

iii. **Disability adjusted life years (DALYs):** It is the easiest and the most commonly used measure to find out the overall burden of disease and the efficiency of the interventions. It is defined as the number of years of healthy life of a person lost due to premature mortality, mortality or disability.

DALY = Years of lost life (YLL) + Years lost to disability (YLD)

To measure DALYs, data on number of the losses due to premature deaths, number of losses of healthy life years resulting from disability that may be permanent (polio) or temporary (TB, leprosy), physical or mental, is needed. One DALY is one lost year of healthy life.

iv. **Quality adjusted life year (QALY):** QALY measures the number of years of life added by an effective treatment or adjustment for better quality of life. It indicates the cost effectiveness of health interventions. Each year in perfect health measures is assigned a value of 1.0 and a value of 0.0 for death.

### *d. Nutritional status indicators*

It is a positive health indicator. Following indicators are considered important as indicators of health status:

1. Weight, length and head circumference at the time of birth.
2. Anthropometric measurements (e.g. weight, height, midarm circumference) of preschool children.
3. Weight and height of children at the time of school entry.

### *e. Utilization rate*

It is the proportion of the people actually receiving the healthcare services in a given population in a given period usually a year, e.g. proportion of infants fully immunized against 6 EPI diseases (measles, tetanus, polio, tuberculosis, pertussis, and diphtheria), proportion of pregnant women getting antenatal care or have deliveries by trained doctor, and percentage of people using various methods of family planning, bed occupancy rate, bed-turnover ratio, etc.

### *f. Indicators of social and mental health*

These include the rates of theft, crimes, assault, murder, suicides, juvenile delinquency, accidents, alcohol and substance abuse, and domestic violence. These indicators are a guide to implement social action for the improvement of the social and mental health of the people.

### *g. Environmental indicators*

These indicators reflect the quality of physical and biological environment and measure the percentage of population having access to good sanitation facilities and safe drinking water. They describe the occurrence of communicable diseases in a given population. These indicators include the indicators relating to measurement of the water pollution, air pollution, soil pollution, noise pollution and exposure to toxic substances in food and water.

### *h. Socioeconomic indicators*

These do not directly measure health status of people but are important in interpreting healthcare indicators. These include rate of increase of population, literacy rates, dependency ratio, housing ratio (number of persons per room, family size, per capita 'calorie' availability). Very less health problems have been reported in countries with favorable socioeconomic indicators.

### *i. Health policy indicators*

One most important indicator of political commitment is allocation of suitable resources. The relevant indicators are:

i. Proportion of budget spent on health services, health activities like nutrition, water supply, community development, sanitation, and housing.
ii. Proportion of total health resources dedicated to primary healthcare.

### *j. Other indicators*

i. **Social indicators:** United Nations Statistical Office have categorized social indicators into various groups including population, families, housing and its environment, learning and educational services, health services, nutrition, income, social security and welfare services, public order and safety, social stratification and mobility time use.

ii. **Basic needs indicators:** These include access to water, calorie consumption, illiteracy, life expectancy, deaths due to illness, doctors and nurses per population, rooms per person.

iii. **'Health for all' (HFA) indicators:** WHO had listed the following four categories of indicators for monitoring towards the goal of health for all by 2020 AD.

A. *Health policy indicators*
- Community involvement
- Degree of equity of distribution of health services
- Political commitment to HFA
- Resource allocation
- Organizational framework and managerial process.

B. *Social and economic indicators related to health*
- Adult literacy rate
- Food availability
- Housing
- GNP or GDP
- Income distribution
- Rate of population growth
- Work conditions.

C. *Indicators for the provision of healthcare*
- Accessibility
- Availability
- Quality of care
- Utilisation.

D. *Health status indicators*
- Child mortality rate (1–4 years)
- Disability prevalence
- Disease specific mortality
- Infant mortality
- Life expectancy at the time of birth
- Low birth weight
- Maternal mortality rate
- Incidence and prevalence of morbidity
- Nutritional status and psychosocial development of children.

## CONCEPT OF DISEASE

Disease is just opposite to health. Disease can be defined as 'an impairment of the normal state of the living animal that affects the performance of the vital functions'. It is also defined as 'a pathological condition of the body that presents a group of symptoms peculiar to it and which sets the condition apart as an abnormal entity differing from other normal or pathological body states'.

Like health, disease is also viewed differently by different people or groups. From a sociological point of view disease is regarded as a social phenomenon occurring in all societies. From an ecological point of view disease is *'maladjustment of the human organism to the environment'.*

The terms disease, illness and sickness have been used synonymously but they are actually different. Whereas **disease** is a physiological/psychological dysfunction, **illness** is a subjective state of the person who feels aware of not being well; and **sickness** is a state of social dysfunction, a role that an individual assumes when ill (sickness role).

Diseases could be physical, mental (psychological) or social. They could be caused by bacteria, and viruses, insects and animal bites, strain, accident, injury, etc.

### Natural History of Disease

Natural history of disease refers to the progress of a disease process in an individual over time, in the absence of intervention. The process begins with exposure to or accumulation of factors capable of causing disease. Without medical intervention, the process ends with recovery, disability, or death (Fig. 1.1).

Natural history of a disease traces the sequence of event in the evolution of a disease; from the initial stage of its pre-pathogenesis phase to its termination as recovery, disability or death in the absence of treatment or prevention. The natural history of one disease differs from another. Similarly, the natural history of same disease may also differ in individuals. It is a key concept in epidemiology.

Natural history of a disease comprises two phases, (a) pre-pathogenesis (progress in the environment), and (b) pathogenesis (progress in the human beings). Thus, natural history of a disease gives us an idea as to how and why a disease is caused and how can it be prevented or cured.

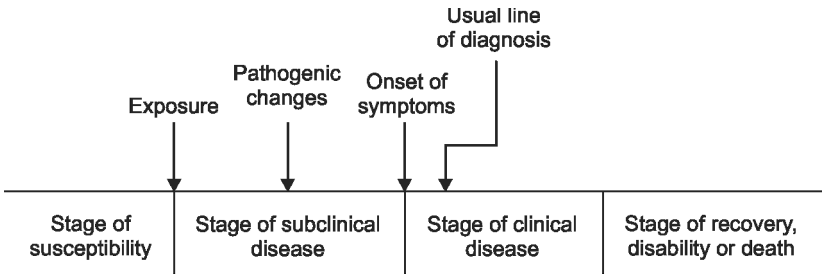


**Fig. 1.1:** Different stages of a disease

### A. Pre-pathogenesis Phase

Every disease is an interaction between **man**, the **causative agent** of the disease and the **environment**. Pre-pathogenesis phase signifies the period when the causative agent has not actually entered the host but the factors are favorable to its interaction with host. Thus the situation could be described as 'man exposed to the risk of disease'. In this way all of us are in the pre-pathogenesis phase of most of the communicable and non-communicable diseases!

### B. Pathogenesis Phase

In this phase the disease agent actually enters the susceptible human host and, in case of infectious diseases, it multiplies and induces tissue and physiological changes. Recovery, disability or death of the host may follow this. Immunisation and chemotherapy serve as intervening measures in pathogenesis phase. The infection may be clinical or subclinical or the host may become a symptomatic or asymptomatic **carrier.** In chronic diseases such as cancer, hypertension, coronary heart diseases, this phase normally consists of a pre-symptomatic phase and a symptomatic phase. In the **pre-symptomatic phase** there are no recognizable symptoms and there is no manifest disease but in the **symptomatic phase** the disease is already well advanced. The sequence of events in the natural history of a disease is shown in detail in Fig. 1.2 and the iceberg of disease is shown in Fig. 1.3.

According to the concept of 'iceberg of disease', disease in a population can be compared with an iceberg. The floating tip of the iceberg represents those persons who have shown symptoms of the disease and are recognized as cases (diseased persons). The vast submerged portion of the iceberg represents latent or in apparant or pre-symptomatic or undiagnosed cases and carriers in

the community. The water line represents the demarcation between clinical and subclinical or undiagnosed patients.

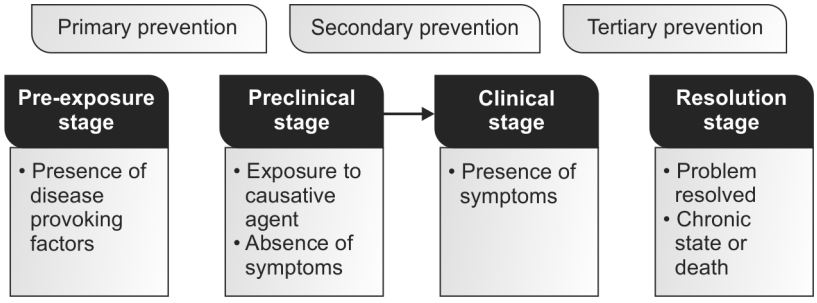


**Fig. 1.2:** Natural history of a disease

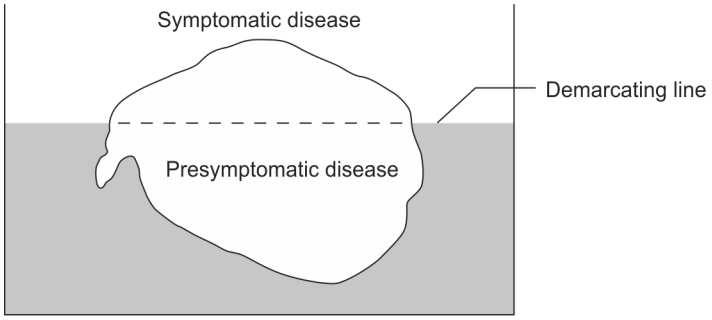


**Fig. 1.3:** Iceberg of disease

In some cases (e.g. hypertension, anemia, diabetes, malnutrition and mental diseases) the unknown morbidity (represented by submerged portion of iceberg) far exceeds the known morbidity. Thus, detection and control of undiagnosed reservoir of disease is challenging.

### *Disease agent*

The word etiology is derived from words *aitia* meaning cause and *ology* meaning science. Hence etiology is the scientific study of the causes of disease. Disease agent is the first link in the chain of disease transmission. It is the most important factor causing the disease (Fig. 1.4).

The disease agent is defined as 'a living or non-living substance or a tangible or intangible force the excessive prevalence or selective lacks of which may initiate or perpetuate a disease process'.

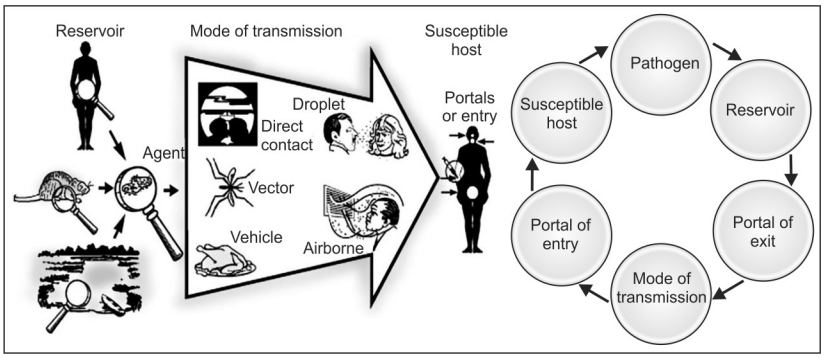


**Fig. 1.4:** Chain of infection

## C. Classification of Etiological Factors

1. **Biological agents:** Viruses, rickettsiae, fungi, bacteria, etc. are the living, biological agents of disease. These living agents exhibit:
    a. **Infectivity** (the ability of an infectious agent to invade, multiply and produce infection in a host).
    b. **Pathogenicity** (the ability to induce clinically apparent illness).
    c. **Virulence** (the degree of pathogenicity). Such agents can multiply in the body and exaggerate the initial danger. They can spread the disease in different parts of the body and produce toxins.
2. **Nutrient agents:** Any excess or deficiency of nutrient agent may result in nutritional disorders. Examples of nutrient agents include carbohydrates, fats, proteins, vitamins, minerals, enzymes and water; and examples of nutritional problems are anemia, goiter, obesity, night blindness, protein energy malnutrition, etc. Dietary deficiency may lower body resistance against infectious diseases.
3. **Physical agents:** Physical agents like heat, cold, humidity, radiation, electricity, sound, etc. may also cause illness. Severe cold can depress the functional efficacy of the ciliated epithelium of the respiratory tract, allowing the passage of bacteria into the lungs. Exposure of whole body to severe heat in combination with humidity can result into a heat stroke. Overexposure to ultraviolet rays causes burns. High voltage currents may cause instantaneous death.
4. **Chemical agents:** Chemical agents may be endogenous or exogenous. Endogenous chemicals are produced inside the body

due to disease, e.g. serum bilirubin (jaundice), calcium carbonate (kidney stone), and uric acid (gout), etc. Exogenous chemical agents are present outside the body but enter the host through inhalation, ingestion, or inoculation, e.g. allergens, fumes, dust, metals, insecticides, gases, etc.

5. **Mechanical agents:** Exposure to mechanical forces may sometimes result into diseases like sprains, dislocations, etc. A mechanical injury may produce a breach in the skin or mucous membrane thus facilitating the entry of organisms into tissues. Mechanical injuries are caused by a collision between the body and an external mass. Mechanical trauma causes disruption of tissue or a wound. Some amount of internal hemorrhage is inevitable but if the skin has been ruptured, there will be external hemorrhage also. Mechanical injuries also cause primary and secondary shock.
6. **Social agents:** These are the social factors that play an important role in the occurrence of disease. Unhygienic living conditions, unhealthy lifestyles, poverty, illiteracy and lack of awareness, smoking, abuse of drugs and alcohol, etc. are the examples of social agents.

## CONCEPT OF PREVENTION OF DISEASE

Prevention is always better than cure. A detailed understanding of the natural history of disease and the causative agents is useful in adopting preventive measures against diseases. The object of preventive medicine is to control the 'cause' and hence the disease processes. Prevention could be better understood by dividing it into:

A. Primary prevention.
B. Secondary prevention.
C. Tertiary prevention.

### A. Primary Prevention

It includes the concept of positive health and indicates intervention in the pre-pathogenesis phase of a disease. It is defined as action taken *before* the onset of disease, which rules out the possibility that a disease will ever occur. Primary prevention is based on measures, which promote general health of the people by protective measures like education, literacy campaigns, and food production. WHO has recommended the following approaches for the primary prevention of chronic diseases, if the 'risk factors' are established. The term

'risk factor' is used to explain the etiology of a disease when the disease agent is not clearly established. It is defined as 'an activity or exposure that is significantly associated with the development of a disease'. It is also defined as a determinant that can be modified by intervention, thereby reducing the possibility of occurrence of disease or other specified outcome.

a. **Primordial prevention:** Primordial (meaning—ancient) prevention is of special interest in prevention of chronic diseases. It is the primary prevention in the real sense. In this approach efforts are directed towards discouraging children from adopting harmful lifestyles mainly through individual and mass education. For example, the diseases like hypertension and obesity have their origin in early childhood when the lifestyles are formed, e.g. eating habits, unhygienic habits, physical exercise, smoking, etc.
b. **Population (mass) strategy:** The population strategy is directed towards the lifestyles, socioeconomic and behavioral changes in the whole population irrespective of individual risk levels. Thus, it has been proved that even a little decline in the average blood pressure of a population would produce a large decrease in the incidence of cardiovascular diseases. Similarly an increase in the average income of a population suffering from malnutrition would improve the health status of the population.
c. **High-risk strategy:** In any population there may be certain individuals who may be at high-risk. High-risk strategy is based on the detection of individuals at high-risk by optimum use of clinical methods. AIDS is a relatively new fatal disease but its rate of spread is alarming. Better control of this disease would anticipate detection of individuals at high-risk and taking preventive care in such cases.

### B. Secondary Prevention

Secondary prevention is related to the preventive measures taken after the occurrence of disease to arrest the disease process and restore health. It can also help in protecting the individuals who have not acquired the disease so far. Hence secondary prevention can prevent spread of infection in already infected persons and at the same time potential contacts get primary prevention. Secondary prevention may be defined as 'action that stops the progress of a disease at its early stage and prevents complications'. These actions include early diagnosis, adequate treatment, governmental health programmes, etc.

However, secondary prevention is an imperfect tool. It is more expensive and less effective than primary prevention. The patient has already suffered from mental stress, pain and the community has been subjected to loss of productivity. This does not happen in primary prevention. Thus long-term health policy would lay greater emphasis on primary prevention as compared to secondary prevention. Primary prevention is safer and least costly.

### C. Tertiary Prevention

It is defined as 'all measures available to reduce or limit impairments and disabilities, minimizing suffering caused by existing departures from good health and to promote the patient's adjustment to intermediate condition'. Tertiary prevention means intervention in the late pathogenesis stage as when the disease process has crossed its early stages. Tertiary prevention, if undertaken in the natural history of disease, may prevent sequel and limit disability. This can be followed by rehabilitation programmes. Tertiary prevention extends the concept of prevention into fields of rehabilitation. Modern day rehabilitation programmes include psychological, vocational and medical components involving the team wok of a variety of professionals.

As per the natural history of disease, epidemiology has derived three levels of prevention of disease, which are summarized in Table 1.1.

**TABLE 1.1:** Levels of prevention of disease

| ***Primary prevention*** | ***Secondary prevention*** | ***Tertiary prevention*** |
|---|---|---|
| a. **Health promotion:** Through health education, nutritional intervention, lifestyle behavioral changes and regular exercises | a. **Early diagnosis:** Regular checkup of community | a. **Disability limitation:** Through proper exercise**,** physio- and occupational therapy, corrective plastic surgery to improve mobility |
| b. **Specific protection:** Through immunisation, chemopro-phylaxis, nutritional supplements, pollution free environment, noise control, standardization of consumer products and accident control | b. **Prompt treatment:** Proper treatment of diagnosed diseases to prevent compli-cations | b. **Rehabilitation:** Mental and physical make-up to become productive, establishing independence and status in the society |

## CONCEPTS OF DISEASE CONTROL

Disease control involves all the measures designed to prevent or reduce the rate of transmission, morbidity and mortality of the infectious disease in local setting to an acceptable level. In disease control, a state of equilibrium becomes established between the disease agent, host and environment components of the disease process and the disease agent persists in population at a level at which it does not pose a problem to public health. The main aims of disease control are as follows:

i. To reduce the incidence of disease.
ii. To reduce the prevalence of disease.
iii. To reduce the duration of disease.
iv. To reduce the consequences of disease.
v. To reduce the risks of transmission of disease.
vi. To reduce the complications of infection.
vii. To reduce the financial burden of the community.

Prevalence of a disease is the product of incidence and the duration of disease ( P = I x D). Therefore, prevalence of a disease depends not only on the actual number of people who develop a disease but also on the duration of a disease. For short duration diseases like common cold, the prevalence and incidence are almost identical while for chronic or long-standing diseases like tuberculosis, leprosy or blindness the prevalence is always much higher than the incidence.

Disease control activities are mainly focused on primary prevention or secondary prevention, or combination of the two. The concept of tertiary prevention is comparatively less relevant to disease control. Malaria is a good example of a disease that can be controlled in local settings. Malaria cannot be entirely eliminated because the mosquito-borne parasites that transmit the disease can develop drug resistance. But it can be controlled through various healthcare and prevention strategies like use of bednets and mosquitoes repellants. Disease control is the first step toward disease elimination.

### Disease Elimination

Elimination of disease implies the interruption of transmission of a disease and reduction of the incidence of disease in a specific geographical area or country to zero. Disease elimination is considered as an important precursor of disease eradication. After several years of elimination, countries contact the WHO for certification.

## Disease Eradication

Disease eradication is termination of all the transmission of infection caused by a specific agent and permanent reduction of the specific disease cases to zero worldwide. Smallpox is the only disease that has been eradicated globally. It was declared officially eradicated by the World Health Organization (WHO) in 1980. Once a disease has been eradicated, intervention measures are no longer needed.

Every disease has its own epidemiological characteristics and specific strategies for control. During recent years, three diseases including polio, measles and dracunculiasis have been considered as candidates for global eradication. The feasibility of eradicating polio appears to be greater than that of others.

## Components of Disease Control

Monitoring, surveillance and evaluation of interventions are necessary to maintain achievements in infectious disease control.

### *i. Monitoring*

Monitoring is the systematic and routine collection of information about all the projects and programmes aimed at detecting changes in the environment or health status of population, e.g. monitoring of air pollution, water quality, growth and nutritional status, etc. It also refers to on-going measurement of performance of a health service or a health professional, or of the extent to which patients comply with the advice from health professionals. It is basically to have a continuous oversight of activities to ensure that they are going according to plan. It also helps the project managers to identify and solve problems quickly. It keeps track of project inputs and outputs such as achievements, staff movements, documentation, finances and budgets, and the money spent in relation to the resources available. Monitoring is an ongoing activity that should be incorporated into everyday project work. The data acquired through monitoring is used for evaluation. Monitoring is routinely carried out by project staff, project partners and peer educators to keep track of their work.

### *ii. Surveillance*

Surveillance is a vital component of any disease control programme. The purpose of surveillance is action. Surveillance for a disease means:

1. To continuously watch over the distribution and trends of incidence of a disease through the systematic collection, consolidation and evaluation of morbidity and mortality.
2. To monitor, observe, or determine health status, diseases or risk factors within a population.

Surveillance can be epidemiological surveillance, demographic surveillance, nutritional surveillance, etc.

The main objectives of surveillance are:

a. To monitor health problems to facilitate their prevention or control.
b. To set priorities, plan, and conduct disease control programs.
c. To assess the effectiveness of control efforts.
d. To provide timely warning of public health disasters so that interventions can be taken.

Surveillance requires professional analysis and sophisticated judgement of data leading to recommendations for control activities. Those persons conducting surveillance:

1. Identify, define, and measure the health problem of interest.
2. Collect and compile data about the problem (and if possible, factors that influence it).
3. Analyze and interpret these data.
4. Provide these data and their interpretation to those responsible for controlling the health problem.
5. Monitor and periodically evaluate the usefulness and quality of surveillance to improve it for future use.

It is to be noted that surveillance of a problem does not include actions to control the problem.

### *iii. Sentinel surveillance*

A sentinel surveillance system is used when high-quality data are needed about a particular disease:

1. To monitor the rate of occurrence of specific disease.
2. To assess the stability or change in health levels of a population that cannot be obtained through a passive system.

Most passive surveillance systems receive data from as many health workers or health facilities as possible, whereas a sentinel system involves only a limited network of carefully selected specific reporting sites or population group. Data collected can be used to estimate disease prevalence, identify outbreaks and monitor the burden of disease in a community. It provides a rapid, economical alternative to other surveillance methods. As sentinel surveillance is conducted only in selected locations, so it may not be as effective

for detecting rare diseases or diseases that occur outside the sentinel sites.

In selecting a sentinel health facility following criteria should be considered:

- It should have easy access to large population.
- It must have qualified specialist to diagnose, treat and report cases of the disease under surveillance.
- It must have a high-quality diagnostic laboratory.

### *iv. Evaluation*

Evaluation is the process by which results of a project are compared with the intended aims, goals and objectives. It is the assessment of how well a programme is performing. It helps to understand how and why the intervention has worked well. In case the project is unsuccessful, then what could have been done better or differently. Evaluation should always be considered during the planning and implementation stages of a programme or activity. Evaluation studies can be useful in generating information on extension of control activities, training and patient management, etc.

## SOCIAL CAUSES OF DISEASES

In addition to genetic reasons, social environment affects the health status of people.

1. **Income and social status**: Poverty increases the chances of poor health. Higher income and social status determine the quality and standard of healthy living and are thus linked to better health. The greater the gap between the richest and poorest people, the greater the differences in health.
2. **Lifestyle:** Lifestyle is the sum total of habits, beliefs. Lifestyle habits like smoking, alcohol, poor diet leading to obesity or malnutrition, lack of physical exercise, sedentary lifestyle and drug abuse increases the chances of poor health.
3. **Social isolation:** Exposure to discrimination, crime and violence is linked with poor health. Social support networks affect the health status of the person. Support from families, friends and communities is linked to better health. Persons who have small number of social contacts are more likely to die earlier than those who have more extended networks.
4. **Literacy level:** Illiteracy is linked with poor health, more stress, and lower self-confidence, increased morbidity, and mortality. Illiterate people are more likely to indulge in unhealthy activities,

such as smoking. People with more education are more likely to live longer. They participate in healthy activities like exercising and visiting their doctor regularly. Education compensates the effect of poverty as educated people get higher-paying jobs that often come with benefits, such as health insurance and healthier working conditions that add up to better health.

5. **Employment and working conditions:** Employed people with healthy working conditions are healthier than unemployed with low morbidity and mortality.
6. **Marital status:** Married persons generally have good health and have a lower mortality risk.
7. **Stress:** Exposure to stressful situations such as death or divorce of parents, desertion, loss of service, birth of a handicapped baby.
8. **Cultural practices:** Health status, morbidity and mortality rate, customs and traditions, and the beliefs of the family and community all affect health.

## SOCIAL PROBLEMS OF SICK

People with illness encounter economic as well as social problems in their everyday life. Illness can be disruptive to sick person's daily life and can interfere with their self-management. A chronic illness may present various challenge for sick person. A person with a visible disability or one who receives special treatment may be singled out by his colleagues. Many of the sick people face difficulty in performing activities of daily living, in solving work-related issues and underachieve at work place for various reasons. Their stamina may be lower or their medication may impair their alertness or make them irritable. They may face difficulty in seeking expert advice on the disease state and treatment due to lack of money and resources. Social problems experienced by patients may have an important impact on their mental health and quality of life. If their illness causes them frustration, they may have emotional or behavioral problems that can interfere with work. Some sick people have conflict over relationships with family and non-family members. Sick people may have difficulty in adapting to changes in the social environment. Lack of local support services, and lack of information on available welfare services during treatment may further worsen their illness.

Sick people have problems, such as family life, relationships with people around them, lifestyle adjustments, work, income, leisure activities, and relationships with healthcare provider.

Treatment of disease alone is not likely to solve the problem of patient. There has been an increasing need for support for their social problems, as well as the mental care of patients. The economic and social problems of the patient and his family should be identified and met. They must be given social assistance and social support, assistance to travel to and from the clinic, help in terms of food grains, clothes, care of children and their education, and job placement, programmes such as slum improvement, etc. Such care should be provided through voluntary agencies and Departments of Social Welfare. Healthcare providers should also actively address the social circumstances of people with chronic illness and the problems they might have with self management.

## SOCIAL AND HEALTH EDUCATION

Health education is combination of learning practices designed to help individuals and communities to promote, improve and restore their health, by increasing their knowledge or influencing their attitudes. It is aimed at encouraging people.

### Aims and Objectives

a. To develop health consciousness in people and encourage them to stay healthy.
b. To arise interest in the people to know how to stay healthy.
c. To encourage people to adopt necessary health practices and maintain healthy lifestyles and attitude to reduce the occurrence of disease, disabilities and deaths.
d. To promote the proper use of available health services by people.
e. To provide health knowledge and skills to people to enable them to identify and solve their health problems.
f. To stimulate individual and community self-reliance and contribution to achieve health development.
g. To provide a healthy environment for physical and mental growth.
h. To improve the health and the quality of life of the individual and community level.

### Approach to Health Education

1. Regulatory approach (managed prevention).
2. Service approach.

3. Health education approach.
4. Primary health care approach.

## Contents of Health Education

1. **Human biology**
   a. Understanding the importance of good health and methods to keep physically fit demands an understanding of human biology.
   b. To provide knowledge about child spacing, safe motherhood, breastfeeding, weaning and child growth, immunisation, respiratory infections, diarrheal disease, house hygiene.
2. **Nutrition**
   a. To provide knowledge about nutrient value of food stuffs.
   b. To guide people to choose balanced diets to prevent malnutrition.
   c. To remove preconceptions and promote good dietary habits.
3. **Hygiene:** To teach people about the importance of hygiene (personal and environmental) and methods of maintaining hygiene.
4. **Family Health**
   a. Strengthen and improve the health of the family.
   b. Disease prevention.
   c. Maternal and child healthcare.
   d. Early diagnosis and care of the ill person.
   e. Family planning, immunisation, nutrition, etc.
5. **Disease prevention and control:** To educate people about locally endemic diseases.
6. **Mental health**
   a. To help people to keep mentally healthy and to prevent a mental breakdown.
   b. To provide basic knowledge of common psychological ailments such as depression, mental anxiety, neurosis, and emotional disturbances
7. **Prevention of accidents:** To teach people about basic safety rules and prevention of common accidents at the home, road and the workplace.
8. **Use of health services:** To inform people about various health services and preventive programmes.

## FOOD IN RELATION TO NUTRITION AND HEALTH

The level of general public health in India is not satisfactory but it has been improving over the years. Food and nutrition are important in maintaining good health. Several non-communicable chronic diseases like hypertension, coronary artery disease, diabetes mellitus and certain types of cancers are due to imbalanced diet and sedentary lifestyle. Nutrition is important in maintaining health.

**Food** may be defined as 'any substance, which can be utilized to yield heat or energy, to build up new tissues and to repair worn-out tissues, to regulate body processes and to aid in the production of important body compounds'.

**Nutrition** may be defined as 'the science of food and its relationship to health'. It is concerned mainly with the role of nutrients in body growth, physical and mental development, and maintenance. Good nutrition is a cornerstone of good health as it increases the body's immunity and decreases the susceptibility to disease.

Public health nutrition may be defined as 'the branch of human nutrition dealing with human health and the services necessary to maintain human health'. It deals with all the schemes of national health services and other health related agencies and institutions to promote human nutrition.

*Dietetics* is the practical application of the principles of nutrition in the prophylaxis and treatment of disease. It includes the making of diet plans for the well and the sick.

Today most of us are aware about the relation between nutrition and infection, immunity, maternal and child health, fertility and family health. Nutritional indicators have been developed to monitor health for all.

### Classification of Foods

Foods can be classified in many ways as shown in Fig. 1.5.

#### *Nutritional levels*

Adequate nutrition enables individuals to grow, mature, reproduce and function in a healthy and normal manner. **Undernutrition** is a shortage in the total essential nutrients in the diet caused by an insufficient supply of food. **Malnutrition** means bad nutrition either due to deficiency or due to excess of one or more nutrients.

## NUTRITIONAL REQUIREMENTS

An adequate diet should perform the following functions:

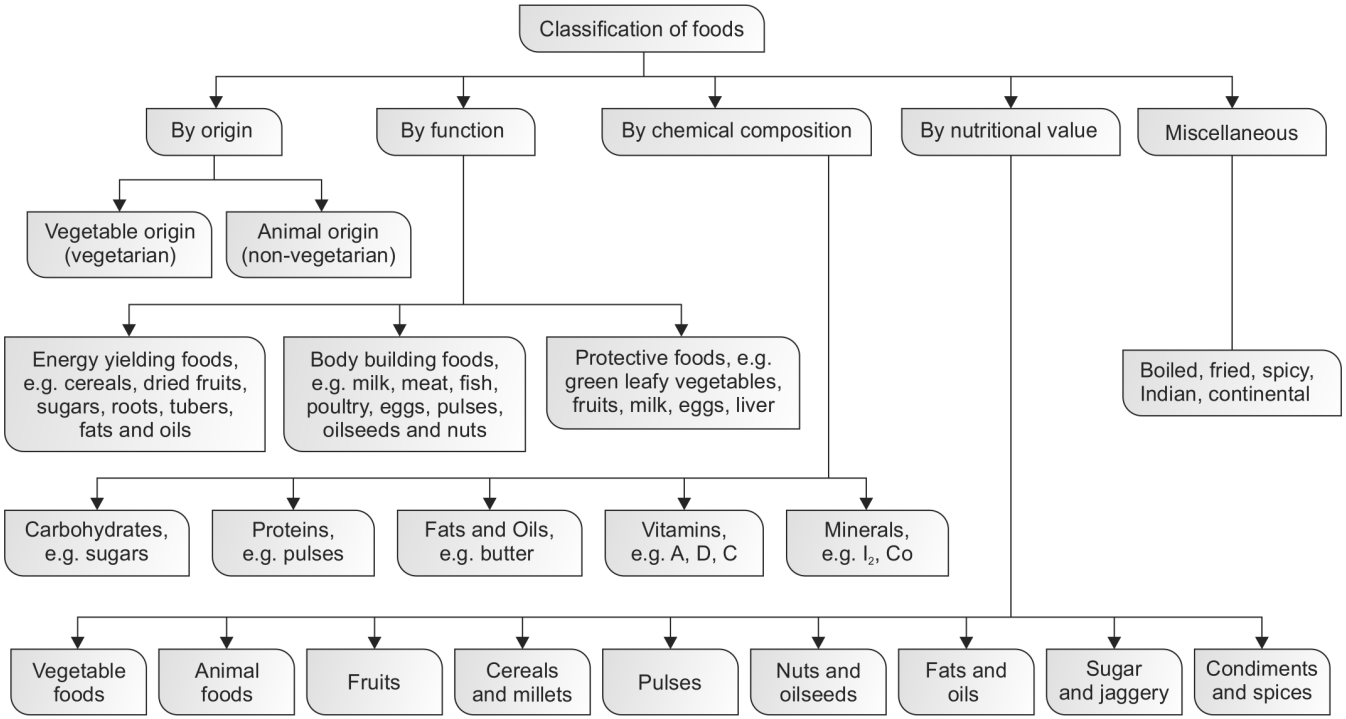


**Fig. 1.5:** Classification of foods

a. It must supply energy for the basal metabolism as well as muscular and other work of the body.
b. It must supply energy and material for the synthesis of structural components necessary for optimum growth.
c. It must supply agents necessary to perform chemical reactions in the above processes.
d. It must supply energy and chemicals for reproduction.

The amount of nutrients needed for the body can be expressed in terms of **Recommended Daily Allowance** (RDA) or **Recommended Daily Intake**. RDA is defined as 'the amounts of nutrients sufficient for the maintenance of health in all the people'. *RDA of different nutrients vary according to the age, sex and special conditions like pregnancy and lactating mothers.*

Common nutritional requirements include proteins, vitamins and minerals.

## 1. Proteins

Proteins are most important for the maintenance of human life. Tissues, muscles, enzymes, organs and hormones are protein in nature. Proteins from diet are important because they provide amino acids for:

a. Synthesis of body proteins in children when they are growing.
b. In adults for synthesis of new proteins to replace those being broken down.
c. In pregnant women for the requirement of the fetus and placenta.
d. For nursing mothers for synthesis of proteins in breast milk.

The body cannot store excess amount of protein. Protein requirement is expressed in terms of grams/kg body weight. The daily requirement of protein for an adult is about 0.83 g/kg body weight. It is desirable that one-fifth of this requirement should be animal protein.

Protein deficiency is related to amino acid deficiency and is accompanied by deficiency of minerals and vitamins.

**Protein calorie malnutrition** (PCM) means deficiency of calories due to deficiency of protein. It is also known as **protein energy malnutrition** (PEM).

### *A. Protein deficiency diseases*

Diseases induced due to deficiency of protein are kwashiorkor, marasmus and marasmic kwashiorkor.

1. **Kwashiorkor:** Kwashiorkor means 'red boy'. It is a severe protein deficiency disease and is the most widespread deficiency disease of the world. Kwashiorkor is usually seen in the children between the age groups of 1 to 4 years. This disease is common in countries of low agricultural productivity, e.g. southern Mexico, northern South America, tropical Africa and India. It is most common in poor rural children.

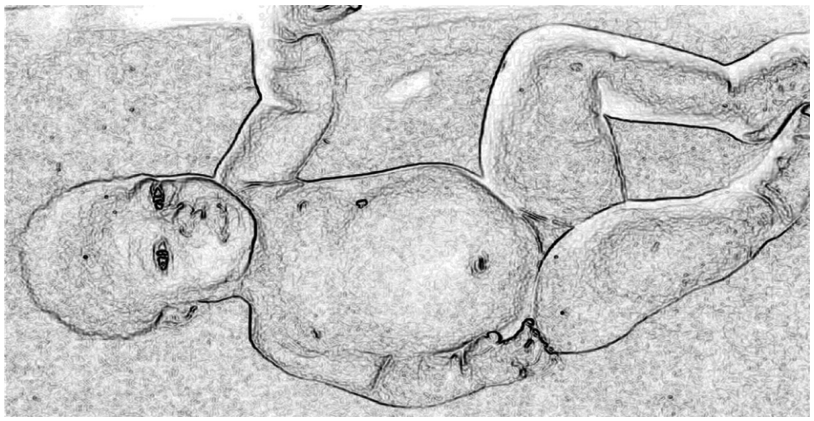

**Fig. 1.6:** Kwashiorkor

Synthesis of two proteins made in the liver is reduced:

a. Plasma albumin, hence edema.
b. Low density lipoproteins, hence lipids accumulate in the liver.

Some of the features of kwashiorkor may be due to associated zinc deficiency. The principal clinical features include:

- Retarded growth
- Anemia
- Loss of appetite
- Edema
- Diarrhea
- Scanty hair growth
- Tissue swelling
- Loss of pigmentation
- Apathy.

Pure cases of kwashiorkor can develop within a few weeks and the patients sometimes have normal weight for age. It is less common than marasmus. Treatment consists of a diet comprised largely of dry skim milk. Improving the quantity and quality of proteins in the diet can prevent the disease.

***Features***

- Edema
- Pale and thinned hair
- Abdominal distension.

2. **Marasmus:** Nutritional marasmus is the commonest severe form of protein-energy malnutrition, i.e. the childhood version of starvation, and involves lack of requisite calories needed by the body. It generally occurs in children between age groups of 0.5 to 5 years. This condition occurs at a younger age than kwashiorkor. The characteristic syndromes include failure to gain weight, wasting of muscles and subcutaneous fat. The child is irritable but feels good appetite.
   The cause of this condition is a poor diet, low in both calories and protein. Poor hygiene leads to gastroenteritis and a vicious circle starts. Diarrhea leads to poor appetite and more dilute foods. In turn, further depletion leads to intestinal atrophy and more susceptibility to diarrhea.

**Fig. 1.7:** Marasmus

***Features***

- Wasted muscles
- Very little fat
- Very underweight
- No edema.

**TABLE 1.2: Difference between kwashiorkor and marasmus**

| S.No. | Kwashiorkor | Marasmus |
|---|---|---|
| 1. | Develops in children more than one year of age due to deficiency of proteins | Develops in infants due to deficiency of proteins, fats and carbohydrates |
| 2. | Extensive edema is present | Edema is absent |
| 3. | Pale and thin hair | Normal hair |
| 4. | Patches of pigmentation and desquamation on skin | No patches of pigmentation and desquamation on skin |
| 5. | Moon face | Old man's face |
| 6. | Subcutaneous fat is present | Subcutaneous fat disappears |
| 7. | Enlarged fatty liver | No fatty liver |
| 8. | Mild or no muscle wasting | Severe muscle wasting |
| 9. | Poor appetite | Voracious feeder |
| 10. | Skin appears to be swollen | Skin is dry and wrinkled |

3. **Marasmic kwashiorkor:** Marasmic kwashiorkor has combined features of both marasmus and kwashiorkor conditions. Severe protein-energy malnutrition have combined spectrum from marasmus to kwashiorkor. Children have some skin lesions, hair changes, and fatty liver (as in kwashiorkor) together with the wasting of marasmus. Malnourished children are mostly depleted in other nutrients also.

### *B. Treatment of protein deficiency induced diseases*

Severe protein deficiency induced diseases can be treated in three phases:

a. **Resuscitation:** For correction of dehydration, acidosis, electrolytes imbalance, hypothermia, hypoglycemia and the treatment of infections.
b. **Start of cure:** Re-feeding, steadily increasing the calories (from 100 to 150 kcal per kg) and protein (to about 1.5 g per kg). There may be anorexia, and children have to be hand fed, if possible in the lap of their mother or a nurse. Potassium, zinc, magnesium and a multivitamin mixture are needed but iron should not be given for the first week.
c. **Nutritional rehabilitation:** After about three weeks, the child does not have edema, has a good appetite, and is no longer ill and but is underweight for age. It takes many weeks of good

feeding for catch up growth to be complete. During this stage the child should be looked after in a recovery home or by its mother, who must be educated about nutrition and be provided with extra food. Locally available foods are best.

### *C. Prevention of protein-energy malnutrition*

To prevent protein-energy malnutrition five measures described below are being actively promoted around the world:

a. **Growth monitoring:** World Health Organization (WHO) has devised a simple growth chart—the Road to Health card. The mother should keep the card and bring the child (plus card) to the nearest clinic regularly for weighing and advice.
b. **Oral rehydration:** UNICEF formula of oral rehydration salt (ORS) is saving many lives from gastroenteritis. It includes:

| | |
|---|---|
| Sodium chloride | 3.5 g |
| Sodium bicarbonate | 2.5 g |
| Potassium chloride | 1.5 g |
| Glucose/sucrose | 20 g/40 g |
| Clean drinking water to make a solution | 1 liter. |

c. **Breastfeeding** is a matter of life and death in a poor community with lack of facilities for hygiene. Additional food, prepared from locally available products, is needed from four to six months of age.
d. **Immunisation** must be done against measles, pertussis, diphtheria, tetanus, polio, and tuberculosis.
e. **Family planning** advice so that people can better take care of their children.

## 2. Vitamins

Vitamins are complex substances that act as coenzymes or partners with enzymes and work as *regulators*. Vitamins are called *micronutrients* as they are needed in small amount by body as compared to carbohydrates, proteins, and fats. Vitamins do not supply energy directly but they do regulate many processes that produce energy. Vitamins are themselves not synthesized by the body in sufficient amounts but they enable the body to use other nutrients.

Vitamins are organic compounds divided into two groups

i. Fat-soluble vitamins.
ii. Water-soluble vitamins.

As their name suggests, fat-soluble vitamins (vitamins A, D, E, and K) dissolve in fat. Our body can store fat-soluble vitamins

in body fat only, thus it is harmful to consume too much of any fat-soluble vitamins (vitamins A and D) in the form of vitamin pills or other dietary supplements for too long-time. High intake of vitamins E and K is usually not toxic. Water-soluble vitamins (B-complex vitamins and vitamin C) dissolve in water. For the most part, water-soluble vitamins are not stored in our body in significant amounts.

### *i. Fat-soluble vitamins*

#### ☛ Vitamin A (Retinol):

**Functions:** Vitamin A plays following vital functions:

a. It works as an antioxidant in the form of carotenoids, and may reduce the risk for certain types of cancers and other diseases of aging.
b. It is necessary for normal growth of bone and skin.
c. It improves vision.
d. It is necessary for differentiation of epithelial tissue.
e. It promotes the growth of cells and tissues in body.
f. It protects us from infections by keeping skin and tissues in our mouth, stomach, intestines; and respiratory, genital, and urinary tracts healthy.

Carotenoids offer health benefits in addition to acting as precursors for vitamin A.

**Deficiency:** Symptoms of a significant deficiency of vitamin A include night blindness, xerophthalmia, dry scaly skin; and poor growth. The deficiency of vitamin A may lead to night blindness, xerophthalmia, Bitot's spots, and keratomalacia.

**Overconsumption:** As vitamin is stored in our body, large intake of vitamin A, can be quite harmful and may cause liver damage, bone and joint pain, headache, vomiting or appetite loss, abnormal bone growth, nerve damage, and birth defects. β-carotene from fruits and vegetables is acceptable.

**Daily requirement:** From age 14 onward, the RDA is 900 μg Retinol Activity Equivalents (RAE) of vitamin A for males and 700 μg RAE for females. During pregnancy the recommendation is 770 μg per day while during breastfeeding recommended daily RAE is 1200 μg.

The tolerable upper intake limit is 2800 μg of RAEs daily for ages 14 to 18, and 3000 μg daily during adulthood. Retinol, β carotene, and other pro-vitamin A carotenoids determine RAE.

*Note:* The RDAs measure vitamin A in Retinol Activity Equivalents (RAEs), reflecting retinol and carotenoid units. The quantity of vitamin A can be expressed in other ways: *International Units* (IU) used for food labels and dietary supplements, or as *Retinol Equivalents* (RE) used in the RDAs and many nutrient databases.

- Vitamin A derived from animal-based foods or supplements: 1 RE = 1 RAE
- Vitamin A derived from plant-based foods: 1 RE = 2 RAE

**Sources:** Main sources of vitamin A are liver, fish oil, carrot, tomato, milk and eggs. Foods fortified with vitamin A include margarine, vanaspati, and milk are also good sources of vitamin A. Carotenoids, such as α-carotene and β-carotene also known as pro-vitamin A carotenoids found in foods of plant origin (e.g. red, yellow, orange, and many dark-green leafy vegetables) get modified to vitamin A in our body.

**TABLE 1.3:** Marketed preparations of vitamin A

| ***Marketed preparation*** | ***Formulation*** | ***Manufacturer*** |
|---|---|---|
| Arovit (7.5 ml) | Drops | Roche Pharmaceutical |
| Aquasol-A | Injection | US Vitamins Limited |
| Vitamin A | Tablet | Abbott Healthcare Pvt Ltd (AHPL) |
| Wyamin | Capsule | Wyeth Ltd. |
| Lipo (Skin) (60 ml) | Lotion | Elder Pharmaceuticals Pvt. Ltd. |

### ☛ Vitamin D (Calciferol)

It is also known as the *Sunshine Vitamin*. Vitamin $D_2$ (calciferol) and vitamin $D_3$ (cholecalciferol) are nutritionally important forms of vitamin D.

**Functions:** It promotes the absorption of two minerals, *viz.* calcium and phosphorus from the gastrointestinal tract and helps in the formation of bones and teeth. It helps to deposit these minerals in bones and teeth, making them stronger and healthier. It controls calcium deposition in bone. Additional vitamin D must be available through the diet in places where solar radiation is insufficient.

**Deficiency:** Vitamin D deficiency is responsible for rickets in growing children and oesteomalacia in adults. Both diseases are common in India.

**Overconsumption:** Too much vitamin D can be toxic, possibly leading to kidney stones /kidney damage, weak muscles and bones, excessive bleeding.

**Daily requirement:** The daily requirements of vitamin D are 2.5 μg (100 IU) for adults, 5 μg (200 IU) for infants and children and 10 μg (400 IU) during pregnancy and lactation.

To maintain healthy bones, the guideline for vitamin D goes up to 10 μg (400 IU) daily for adults over age 50. Over 70 years, the guideline increases to 15 μg (600 IU) per day.

1 μg cholecalciferol = 40 IU vitamin D

**Sources:** Skin can make vitamin D on exposure to sunlight. Only 20 to 40 minutes of sun exposure on hands, arms, and face is needed three times a week to get enough vitamin D. Darker skin needs more sun exposure than lighter skin. Older people's skin is less efficient at converting sun exposure to vitamin D. Other sources of vitamin D are egg yolk and fish liver oils, milk, butter. Cheese, and some fishes (like sardines and salmon), and fortified breakfast cereals and margarine also contain small amounts of vitamin D.

**TABLE 1.4:** Marketed preparations of vitamin D

| Marketed preparation | Formulation | Manufacturer |
|---|---|---|
| Rocaitrol | Capsules | Abott Healthcare Pvt. Ltd. |
| Calcit SG | Tablets | Zydus Cadila Healthcare Ltd. |
| Arachitol | Injection | Solvay Pharma India Pvt. Ltd. |
| Calotec $D_3$ | Powder | Lupin Laboratories |
| Sorvate | Ointment | Glenmark |

### ☛ Vitamin E (Tocopherol)

It occurs as alpha, beta, gamma and delta tocopherols.

**Functions:**

i. It works as good antioxidant by preventing the oxidation of low density lipids (LDL), cholesterol, and perhaps lowering the risk for heart disease and stroke. Its antioxidant activity also may help to reduce the risk of other health problems, such as some types of cancer.
ii. It is essential for normal functioning of reproductive organs.

**Deficiency:** Reproductive failure.

**Overconsumption:** Eating plenty of vitamin E rich foods does not produce a problem. However, taking large doses of it as a dietary supplement appears to have no benefits and hence it is not recommended.

**Daily requirement:** The RDA guideline for males and females age 14 and over is 15 mg of α-tocopherol each day. Depending on their age children need lesser vitamin E. During pregnancy, women still need 15 mg daily; during breastfeeding the recommendation goes up to 19 mg daily.

*Note:* Vitamin E is a group of substances called tocopherols with different potencies. α-tocopherol is its most potent form. On food and supplement labels, the amount is given in International Units (IU) of α-tocopherol, *not* in milligrams. Fifteen milligrams of α-tocopherol is equal to: about 22 IU of *d*-α-tocopherol (natural vitamin E) and about 33 IU of *dl*-α-tocopherol (a synthetic form in fortified foods and some supplements). The 'natural' form of vitamin E is more fully used than the synthetic form.

**Sources:** The richest sources of vitamin E are seed oils and wheat germ oil, green leafy vegetables, fats of vegetable origin.

**TABLE 1.5:** Marketed preparations of vitamin E

| *Marketed preparation* | *Formulation* | *Manufacturer* |
|---|---|---|
| EEE | Capsule | Cadila Pharmaceuticals Ltd. |
| E-Cap | Capsule | Glenmark Pharmaceuticals Ltd. |
| Evitam Sg | Softgel capsule | Cipla Limited |
| Evion | Softgel capsule | Merck Limited (India) |
| Bio-E | Capsule | Dr. Reddy's laboratories |

### ☛ Vitamin K

There are three derivatives of vitamin K, *viz.* $K_1$ (phylloquinone), $K_2$ (menaquinone), $K_3$ (menadione), which refer to a group of related compounds derived from menadione. Vitamin K is stable to heat and exposure to air but is destroyed by light, strong acids, alkalis and oxidizing agents.

**Functions**

i. Vitamin K helps in blood clotting. Synthesis of the four blood clotting factors, II, VII, IX and X is dependent on vitamin K.
ii. It helps to make some proteins that cause our blood to coagulate, or form a clot, when there is bleeding. In this way, bleeding stops.

iii. It also promotes the formation of some other body proteins for our blood, bones, and kidneys.

**Deficiency:** Deficiency of vitamin K causes hypoprothrombinaemia. Blood does not coagulate normally and therefore blood-clotting time is significantly prolonged. This may lead to hemorrhages.

**Overconsumption:** No symptoms have been observed but control is still the best approach. People taking blood thinning drugs, or anti-coagulants, need to eat foods with vitamin K in moderation.

**Daily requirement:** The daily requirement for an adult is 0.03 mg/kg body weight. During adulthood the intake goes up, i.e. 120 μg and 90 μg daily for men and women, respectively. The recommendations remain the same during pregnancy or breastfeeding. To make sure infants have enough, newborns typically receive a shot of vitamin K.

**Sources:** Like vitamin D, our body can produce vitamin K on its own from certain bacteria in our intestines. The best food sources are green leafy vegetables such as spinach and broccoli. However, a variety of foods, milk and other daily foods, meat, eggs, cereal, fruits and other vegetables provide smaller amounts.. Vitamin K is synthesised by bacteria of large intestine.

**TABLE 1.6:** Marketed preparations of vitamin K

| Marketed preparation | Formulation | Manufacturer |
|---|---|---|
| KVI | Injection | Dewcare Concept Pvt. Ltd. |
| K Stat | Injection | Mercury Laboratories Ltd. |
| Kapilin | Injection | Galxo-Smithkline Pharmaceuticals Ltd. |
| Styptindon | Injection | Zydus Alidac |
| Phytonadione | Injection | Dr. Reddy's Laboratories Inc. |

**TABLE 1.7:** Major food sources, function, deficiency and toxicity symptoms of fat-soluble vitamins

| *Nutrient* | *Major food sources* | *Function* | *Deficiency symptoms* | *Toxicity symptoms* |
|---|---|---|---|---|
| Vitamin A | Liver, egg yolk, dark green and deep yellow | Preserves integrity of epithelial cells; C | Night blindness, dry eyes, poor bone growth, | Fatigue; night sweats; vertigo; headache; dry |

*Contd.*

**TABLE 1.7:** Major food sources, function, deficiency and toxicity symptoms of fat-soluble vitamins *(Contd.)*

| ***Nutrient*** | ***Major food sources*** | ***Function*** | ***Deficiency symptoms*** | ***Toxicity symptoms*** |
|---|---|---|---|---|
| | vegetables and fruits | formation of rhodopsin for vision in dim light; wound healing, growth, and normal immune function | impaired resistance to infection, papillary hyperkeratosis of the skin | and fissured skin; lips; hyper-pigmentation; retarded growth; bone pain; abdominal pain; vomiting; jaundice; hyper-calcemia |
| Vitamin D | Egg yolk, liver, fatty fish, sunlight | Bone formation; promotes the absorption of calcium and phosphorus in the intestine | Rickets (symptoms: costochondral beading, epiphyseal enlargement, cranial bossing, bowed legs, persistently open anterior fontanelle) | Hyper-calcemia, retarded growth, vomiting, nephrocalci-nosis |
| Vitamin E | Vegetable oils; liver; egg yolk; butter; green leafy vegetables; whole-grain breads, cereals, and other fortified or enriched grain products; wheat germ | Antioxidant in the tissues; coenzyme; neuromuscular function | Hemolytic anemia in the premature and newborn; hyporeflexia, and spino-cerebellar and retinal degeneration | Prolonged bleeding and clotting time. |

*Contd.*

**TABLE 1.7:** Major food sources, function, deficiency and toxicity symptoms of fat-soluble vitamins *(Contd.)*

| *Nutrient* | *Major food sources* | *Function* | *Deficiency symptoms* | *Toxicity symptoms* |
|---|---|---|---|---|
| Vitamin K | Infant formula, vegetable oils, green leafy vegetables, pork, liver | Catalyzes prothrombin synthesis; required in the synthesis of other blood clotting factors | Prolonged bleeding and prothrombin time; hemorrhagic manifestations | Possible hemolytic anemia; jaundice |

### *ii. Water-soluble vitamins*

#### ☛ Vitamin $B_1$ (Thiamine)

**Functions**

i. Thiamine acts as thiamine pyrophosphate (TPP) in oxidative decarboxylation of pyruvate.
ii. It is essential in the synthesis of pentoses and NADPH (nicotinamide adenine dinucleotide phosphate).
iii. It is also involved in nerve impulse transmission.
iv. It is essential for repair and growth of tissues.

**Deficiency**

a. The principal thiamine deficiency disease is beriberi. It is classified into dry, wet and infantile beriberi. Dry beriberi is characterized by peripheral polyneuritis, paralysis and muscle atrophy. Wet beriberi is characterized by congestive heart failure with cardiac dilatation, damage of the cardiac musculature, serous effusions and edema. Infantile beriberi is the leading cause of infant mortality in many developing areas of the world.
b. Generally thiamine deficiency affects the cardiovascular, muscular, nervous and gastrointestinal systems.
c. In alcoholics vitamin $B_1$ deficiency causes Wernicke's syndrome and Korsakoff's syndrome.

**Daily requirement:** The RDA for thiamine is tied to our energy needs: 1.2 mg daily for males age 14 through adulthood. For females, the recommendation is 1 mg daily from ages 14 to 18 and 1.1 mg daily from age 19 onwards. During pregnancy and breastfeeding, the recommended amount may go up to 1.4 mg daily.

**Sources:** It is present in cereals, legumes, pulses, nuts, yeasts, whole-grain, pork, meat, eggs, liver, nuts, fish. It is also present in small amounts in milk, cheese, and vegetables.

**TABLE 1.8:** Marketed preparations of vitamin $B_1$ (thiamine)

| ***Marketed preparation*** | ***Formulation*** | ***Manufacturer*** |
|---|---|---|
| Therabine | Injection | Parex Pharmaceuticals Pvt. Ltd. |
| Berin | Tablet | GlaxoSmithKline Pharmaceuticals Ltd. |
| BENALGIS | Tablet | Franco Indian Pharmaceuticals Pvt. Ltd. |
| RB 1 | Tablet | Regardia Pharmaceuticals |
| Fide 75 | Tablet | Psycogen Captab |

### ☛ Vitamin $B_2$ (Riboflavin)

**Functions:**

i. It helps to produce energy in all cells of our body.
ii. It helps in conversion of tryptophan amino acid in our food into niacin.
iii. It helps in RBCs production.

**Deficiency:** Riboflavin deficiency is common in India. It is characterized by cheilosis, angular stomatitis, glossitis, seborrheic dermatitis, scrotal deformities and ocular manifestations like corneal vascularization, photophobia, itching, burning and circumcorneal capillary engorgement. Deficiency symptoms also include eye disorders (including cataracts), dry and flaky skin and a sore, red tongue.

**Overconsumption:** No problem reported.

**Daily requirement:** Like thiamine, the RDA for riboflavin is tied to our energy needs. Adult men need 1.3 mg daily while adult women need 1.1 mg daily. During pregnancy, the recommendation is 1.4 mg and, during breastfeeding the amount goes up to 1.6 mg daily.

**Sources:** Milk and other dairy products are major sources of riboflavin. Some organ meats like liver, kidney, and heart are also excellent sources. Eggs, green leafy vegetables, and nuts supply smaller amounts. Riboflavin content of pulses and cereals can be increased by germination.

Note: Since sunlight (ultraviolet light) destroys riboflavin, milk should be packed in opaque plastic or cardboard containers, not in clear glass containers.

**TABLE 1.9:** Marketed preparations of vitamin $B_2$

| *Marketed preparation* | *Formulation* | *Manufacturer* |
|---|---|---|
| Riboflavin | Tablet | Shraya |
| Anvit fort | Capsule | Anrose Pharma |
| Retolbid | Capsule | East African |
| Savent plus | Tablet | Saviour Drugs |
| Vitone | Capsule | Cosmas Pharmacis |

### ☛ Vitamin $B_3$ (Niacin)

It is also known as nicotinic acid. Niacin is readily converted to niacinamide (nicotinamide) in human. Strictly speaking niacin is not a vitamin as it may be synthesized endogenously from the essential amino acid, tryptophan in the presence of vitamin $B_6$ as pyridoxal phosphate. Sixty milligrams of tryptophan provide 1 mg of niacin. Niacin intake is therefore expressed in terms of niacin equivalents (NE) where:

1 NE = 1 mg niacin (nicotinic acid) = 60 mg tryptophan

**Functions**

i. Niacin reduces hyperlipidemia, since it reduces LDL cholesterol (bad cholesterol) and increases HDL cholesterol (good cholesterol).
ii. It is essential for the metabolism of carbohydrates, fat and protein.
iii. It is required for the normal functioning of skin, intestinal and nervous systems.
iv. It helps the enzymes to function normally in body.
v. It helps to produce energy in all the cells of our body.

**Deficiency:** Niacin deficiency can lead to nutritional disease called *pellagra,* which presents as the **4 D's**—*dermatitis, diarrhea, dementia and death*. Early signs of niacin deficiency include fatigue, anorexia, weakness, mild gastrointestinal disturbance, anxiety, irritability and depression. A scaly, bilateral, pigmented dermatitis appears generally in areas exposed to sunlight.

**Overconsumption:** Consuming excessive amounts, likely from a dietary supplement, may cause flushed skin, rashes, or liver damage.

**Daily requirement:** Niacin recommendations are given in Niacin Equivalents (NE). Like thiamine and riboflavin, its recommendation

is tied to energy needs. The advice for adult males is 16 mg NE daily, and for adult females, 14 mg NE daily. During pregnancy, 18 mg NE is advised and during breastfeeding, 17 mg NE daily is recommended.

**Sources:** High protein foods are typically good sources of niacin like poultry, fish, meat, yeast, beef, nuts, butter, whole grains and legumes. Niacin is also added to many enriched and fortified grain products.

**TABLE 1.10:** Marketed preparations of niacin

| *Marketed preparation* | *Formulation* | *Manufacturer* |
|---|---|---|
| 5 -HTPN | Capsule | Molekule India Pvt. Ltd. |
| Bilamide | Tablet | Johnson & Johnson |
| Nicocin ER | Tablet | Ordain Health Care Pvt. Ltd. |
| Neasyn-SR | Tablet | Torrent Pharmaceuticals Ltd. |
| Nialip | Capsule | Dr. Reddy's Laboratories Ltd. |

### ☛ Vitamin $B_6$

It refers to three pyridines: pyridoxine, pyridoxal and pyridoxamine. These compounds are closely related and are converted to the biologically active coenzyme form of pyridoxal phosphate. In animal products, vitamin $B_6$ is found largely as pyridoxal and pyridoxamine. In plants the main form of vitamin $B_6$ is pyridoxine.

**Functions:**

i. It is important in proteins metabolism.
ii. It helps our body to make non-essential amino acids, or protein components, which are then used to make body cells.
iii. It helps in conversion of tryptophan amino acid into two important body substances: Niacin and serotonin.
iv. It helps to produce other body chemicals, including insulin, hemoglobin, and antibodies that fight infection.

**Deficiency:** Vitamin $B_6$ deficiency causes dermatitis, peripheral neuritis, retarded growth, loss of hair, premature greying of hair, convulsions, depression, nausea, or greasy and flaky skin.

**Overconsumption:** Large doses, taken over time, can cause nerve damage.

**Daily requirement:** The RDA is 1.3 mg daily for adult males and females through age 50 years. After age 50, the RDA increases

to 1.7 mg daily for males and 1.5 mg for females. The amount increases to 1.9 mg daily during pregnancy and 2.0 mg daily during breastfeeding.

**Sources:** Chicken, fish, pork, liver, and kidney are the best sources of vitamin $B_6$. Green vegetables, whole grains, soyabean, peanuts, banana, bran of cereals and legumes also supply reasonable amounts of vitamin $B_6$.

**TABLE 1.11:** Marketed preparations of vitamin $B_6$

| *Marketed preparation* | *Formulation* | *Manufacturer* |
|---|---|---|
| Folikit | Tablet | Unique Life Sciences |
| Spera 69 | Tablet | Indoco Remedies Ltd. |
| Genprot | Syrup | Cipla Pharmaceutical Limited |
| Swimor OD EC | Tablet | Swiss Pharma Pvt. Ltd. |
| Pyridoxine 50 mg | Tablet | Wockhardt Ltd. |

### ☛ Pantothenic acid

**Pantothenic acid**, also called **vitamin $B_5$**, is a water-soluble B vitamin and an essential nutrient. Its name derives from the Greek *pantos*, meaning 'from everywhere', as small quantities of pantothenic acid are found in nearly every food. Pantothenic acid is the combination of pantoic acid and β-alanine. As a dietary supplement ingredient, it is commonly found as calcium pantothenate.

**Functions:**

i. Pantothenic acid is a component of coenzyme-A, which functions in acyl transfer reactions of the citric acid (Krebs) cycle.
ii. It helps our body cells to produce energy.
iii. It helps to metabolize or use proteins, and carbohydrates from food.
iv. It is also involved in the metabolism of lipids and in the synthesis of steroids.

**Deficiency:** Dietary deficiency of pantothenic acid is rare in healthy people. Symptoms of its deficiency are abdominal pain and soreness, nausea, personality changes, insomnia, impaired adrenal function, weakness and cramps in the legs, paresthesia of the hands and feet and impaired antibody production.

**Overconsumption:** Occasional diarrhea and water retention.

**Daily requirement:** The AI (adequate intake) for pantothenic acid is 5 mg daily for ages 14–18 and for adults. During pregnancy and breastfeeding, the AI increases to 6 and 7 mg, respectively.

**Sources:** It is widely available in food. Meat, poultry, fish, whole-grain cereals, and legumes are among the better sources. Milk, vegetables, and fruits also contain varying amounts.

**TABLE 1.12:** Marketed preparations of pantothenic acid (vitamin $B_5$)

| *Marketed preparation* | *Formulation* | *Manufacturer* |
|---|---|---|
| Glentona | Syrup | Glenmark Pharmaceuticals Ltd. |
| Oxi Red | Red | Intra Labs India Pvt. Ltd. |
| Mittavin | Capsule | Nicholas Piramal India Ltd. |
| Optineuron | Tablet | Lupin Laboratories Ltd. |
| Supradyn | Tablet | Piramal Enterprises Ltd. |

### ☛ Folic acid

Folate and folic acid (also called vitamin $B_9$) are forms of a water-soluble B vitamin. Folate occurs naturally in food, and folic acid is the synthetic form of this vitamin. Folic acid occurs either as free or bound folate form and often used in combination with other B vitamins.

**Functions:**

i. It plays an essential role in making new body cells.
ii. It works with vitamin $B_{12}$ to form hemoglobin in red blood cells.
iii. It may help to protect against heart disease.
iv. It helps to lower the risk of delivering a baby with neural tube defects such as spina bifida, and it helps to control plasma homocysteine levels, which is associated with increased risk of cardiovascular disease.
v. It increases appetite.

**Deficiency:** Folate deficiency affects normal cell division and protein synthesis, especially impairing growth. Pregnant women, who do not get enough folate, especially during the first trimester, have a greater risk of delivering a baby with neural tube defects such as spina bifida (the neural tube in an embryo becomes the spinal cord and brain). To reduce risk, all women of child-bearing

age should consume adequate amounts. Deficiency of folate may also cause megaloblastic anemia, infertility or even sterility.

**Overconsumption:** Overconsuming can mask a vitamin $B_{12}$ deficiency and may interfere with certain medications. Taking excess amounts as a dietary supplement offers no known benefits.

**Daily requirement:** For folate, the RDA for males from age 14 through adulthood is 400 μg daily. Women capable of becoming pregnant (14 to 50 years) should get 400 μg of folic acid daily from fortified foods, vitamin supplements, or a combination of the two, in addition to the folate found naturally in certain foods. Pregnancy increases the recommended amount to 600 μg daily and during breastfeeding, 500 μg are advised.

**Sources:** It is present in large amounts in fresh green leafy vegetables, cauliflower, liver, kidney and yeast. Orange juice, lentils, dried beans, spinach, broccoli, peanuts, and avocados are among the good sources of naturally occurring folate. Enriched grain products, such as most of breads, flour, crackers, corn grits, cornmeal, farina, rice, macaroni, and noodles must be fortified with folic acid. It is also synthesized by intestinal bacteria. Most of the folic acid is destroyed during cooking.

**TABLE 1.13:** Marketed preparations of folic acid

| *Marketed preparation* | *Formulation* | *Manufacturer* |
|---|---|---|
| Olic | Tablet | Ozone Pharmaceuticals Ltd. |
| Foldivit | Tablet | Cadila Pharmaceuticals Ltd. |
| Folvite | Tablet | Wyeth Pharmaceuticals Ltd. |
| Folitab | Tablet | Intas Pharmaceuticals Ltd. |
| Vacofol | Tablet | Sandoz Pvt. Ltd. |

### ☛ Vitamin $B_{12}$

Cyanocobalamin or vitamin $B_{12}$ is a water-soluble vitamin synthesized exclusively by microorganisms.

**Functions:**

i. It works closely with folate to make red blood cells.
ii. It serves as a vital part of many body chemicals and so occurs in each body cell.
iii. It helps our body to use fatty acids and some amino acids.

**Deficiency:** It is mainly stored in liver in coenzyme forms and hence deficiency is rare. Deficiency of vitamin $B_{12}$ causes megaloblastic anemia and may also result in fatigue, nerve damage, a smooth tongue, or very sensitive skin. Nutritional Megaloblastic Anemia (NMA) is common in India. Foods fortified with vitamin $B_{12}$ or dietary supplements can prevent vitamin $B_{12}$ deficiency.

A deficiency of vitamin $B_{12}$ can also be masked, if extra folic acid is taken to treat or prevent anemia. People who develop pernicious anemia miss a body chemical called *intrinsic factor*. This problem can be medically treated with injections of vitamin $B_{12}$.

**Overconsumption:** No symptoms are known, but taking extra vitamin $B_{12}$ to boost energy is useless.

**Daily requirement:** The RDA is 2.4 μg daily for adults. The recommendation increases to 2.6 μg daily during pregnancy and 2.8 μg daily during breastfeeding.

**Sources:** It is present in large amounts in animal products, liver, kidney, meat, eggs, fish, yeast, milk and cheese. It is also synthesized by bacteria in colon.

### ☛ Vitamin C (Ascorbic acid)

**Functions:**

i. It works as an antioxidant to inhibit damage to body cells.
ii. It helps in the formation of collagen, or the intracellular cement substance, which is necessary for body growth, tissue repair and wound healing.
iii. It helps to keep capillary walls and blood vessels firm, and so protects our body from bruising.
iv. It helps our body to absorb iron and copper from plant sources of food.
v. It helps to keep our gums healthy.
vi. It helps in the synthesis of adrenaline and hydrocortisone.
vii. It protects us from infection by stimulating the formation of antibodies, which boost our body immunity.
viii. Vitamin C may also play a role in membrane permeability, leukocyte function and prevention of accumulation of histamine in the body.
ix. Roles of ascorbic acid in prevention of common cold and protection against infection are yet to be proved scientifically.

**Deficiency:** A severe deficiency of vitamin C leads to scurvy. Its deficiency also causes anemia, joint pain, hemorrhages in skin and other hemorrhages. Wounds may not heal properly either. Because

vitamin C rich foods are widely available, so its deficiency is no longer a common deficiency.

**Overconsumption:** Since vitamin C is water-soluble, our body excretes the excess. Very large doses may cause kidney stones and/or diarrhea, and for those with iron overload, excessive vitamin C (which enhances iron absorption) can worsen the problem.

**Daily requirement:** The RDA for females and males ages 14–18 is 65 mg and 75 mg of vitamin C daily, respectively. Adult males need 90 mg daily; adult females, 75 mg of vitamin C daily for everyday needs (about the amount in 3/4 cup of orange juice). Women need somewhat more during pregnancy (80 to 85 mg) and breastfeeding (115 to 120 mg). For people who smoke, the RDA for vitamin C is increased by 35 mg daily to help counteract the oxidative damage from nicotine.

**Sources:** Vitamin C mainly comes from plant sources of food. All citrus fruits, including oranges, grapefruits, and tangerines, are good sources. *Amla* is one of the richest sources of ascorbic acid. Many other fruits and vegetables, including berries, melons, peppers, fresh green and leafy vegetables, potatoes and tomatoes also supply significant amounts.

**TABLE 1.14:** Marketed preparations of vitamin C

| *Marketed preparation* | *Formulation* | *Manufacturer* |
|---|---|---|
| Celin | Tablet | Glaxosmithkline Pharmaceuticals |
| Cell-c, Limcee | Tablet | Nicholas Piramal India Ltd. |
| Chewcee | Tablet | Wyeth Ltd. |
| Redoxon | Tablet | Nicholas Piramal India Ltd. |
| Cecon | Drops | Pfizer Limited (Pharmacia India Pvt. Ltd). |

### ☛ Vitamin $B_7$ (Biotin)

Biotin is a water-soluble B-vitamin that helps our body convert food into energy. It is especially important during pregnancy and breastfeeding. In addition, biotin is important for the health of our hair, skin and nails.

**Functions:**

i. It helps our body to produce energy in cells.
ii. It helps in metabolism of proteins, fats, and carbohydrates.

**Deficiency:** Poor growth, loss of muscular control, loss of appetite, hair fall, weakness,

**Overconsumption:** Not reported.

**Daily requirement:** The adequate intake (AI) for biotin is 30 μg daily for adult males and females, including during pregnancy. The AI increases to 35 μg daily during breastfeeding.

**Sources:** Biotin is found in a wide variety of foods. Egg yolk, fish, milk, yeast breads, nuts, honey, liver, meat and cereals are among the best sources.

**TABLE 1.15:** Marketed preparations of biotin

| *Marketed preparation* | *Formulation* | *Manufacturer* |
|---|---|---|
| Apotin | Tablet | Apotex Life Sciences |
| Axytin | Tablet | Axyzen Life Sciences |
| Beten forte | Tablet | Dr. Derma Expert Skin Care & Cure |
| Weltin | Capsule | Articon Labs |
| Wintin | Tablet | Dermawin Pharmaceuticals |

**TABLE 1.16:** Major food sources, function, deficiency and toxicity symptoms of water-soluble vitamins

| *Vitamin* | *Major food sources* | *Function* | *Deficiency symptoms* | *Toxicity symptoms* |
|---|---|---|---|---|
| Ascorbic acid (vitamin C) | Infant formula; citrus fruits; papaya; strawberries; vegetables (potatoes; cabbage) | Essential in the synthesis of collagen and thus; strengthens tissues and improves wound healing and resistance to infection; iron absorption and transport; antioxidant | Scurvy; pinpoint peripheral haemorrhages; bleeding gums; diarrhea | Nausea; abdominal cramps; diarrhea; possible formation of kidney stones |
| Thiamin (vitamin $B_1$) | Breast milk; infant formula; lean | Combines with phosphorus to form thiamin | Beriberi; neuritis; edema; | |

*Contd.*

**TABLE 1.16:** Major food sources, function, deficiency and toxicity symptoms of water-soluble vitamins *(Contd.)*

| *Vitamin* | *Major food sources* | *Function* | *Deficiency symptoms* | *Toxicity symptoms* |
|---|---|---|---|---|
| | pork; wheat germ; whole-grain and enriched breads; cereals; and other grain products; legumes; potatoes | pyrophosphate (TPP) necessary for metabolism of protein; carbohydrate; and fat; essential for growth; normal appetite; digestion; and healthy nerves | cardiac failure | |
| Riboflavin (Vitamin $B_2$) | Meat; dairy products; egg yolk; legumes; green vegetables; whole-grain breads; cereals; and fortified or enriched grain products | Essential for growth; plays enzymatic role in tissue respiration and acts as a transporter of hydrogen ions; synthesis of FMN and FAD | Photophobia; cheilosis; glossitis; corneal vascularization; poor growth | |
| Niacin (Vitamin $B_3$) | Meat; poultry; fish; whole-grain breads; cereals; and fortified or enriched grain products; egg yolk | Part of the enzyme system for oxidation; energy release; necessary for synthesis of glycogen and the synthesis and breakdown of fatty acids | Pellegra: dermatitis; diarrhea; dementia | Transient due to the vasodilating effects of niacin; flushing; tingling; dizziness; nausea; liver abnormalities; hyperuricemia; decreased |

*Contd.*

**TABLE 1.16:** Major food sources, function, deficiency and toxicity symptoms of water-soluble vitamins *(Contd.)*

| *Vitamin* | *Major food sources* | *Function* | *Deficiency symptoms* | *Toxicity symptoms* |
|---|---|---|---|---|
| | | | | LDL and increased HDL cholesterol |
| Pyridoxine (vitamin $B_6$) | Liver; meat; whole-grain breads; cereals; or other grain products; legumes; potatoes | Aids in the synthesis and breakdown of amino acids and unsaturated fatty acids from essential fatty acids; essential for conversion of tryptophan to niacin; essential for normal growth | Microcytic anemia; convulsions; irritability | Sensory neuropathy with progressive ataxia; photo sensitivity |
| Biotin (vitamin $B_7$) | Infant formula; liver; meat; egg yolk; yeast; bananas; most vegetables; strawberries; grapefruit; watermelon; | Essential component of enzymes; important in reactions involving the lengthening of carbon chains; coenzyme carrier of carbon dioxide; plays an important role in the metabolism of fatty acids and amino acids | Seborrheic dermatitis; glossitis; nausea; insomnia; | |
| Cyano-cobalamin (vitamin $B_{12}$) | Meat; fish; poultry; cheese; egg yolk; liver | Essential for biosynthesis of nucleic acids and | Pernicious anemia; neurologic deterioration | |

*Contd.*

**TABLE 1.16:** Major food sources, function, deficiency and toxicity symptoms of water-soluble vitamins *(Contd.)*

| *Vitamin* | *Major food sources* | *Function* | *Deficiency symptoms* | *Toxicity symptoms* |
|---|---|---|---|---|
| | | nucleoproteins; red blood cell maturation; involved with folate metabolism; central nervous system metabolism | | |
| Folic acid | Liver; green leafy vegetables; legumes; whole-grain breads; cereals; and fortified or enriched grain products; legumes; oranges; cantaloupe; lean beef | Essential in the biosynthesis of nucleic acids; necessary for the normal maturation of red blood cells | Poor growth; megalo-blastic anemia | Masking of $B_{12}$ deficiency symptoms in those with pernicious anemia not receiving cyano-cobalamin |

The recommended vitamins intake for individuals are summarized in Table 1.18.

### 3. Minerals

A number of minerals are essential for body functions. They are classified as *macro*minerals or *micro*minerals (trace elements) depending on their dietary requirement. The macrominerals include calcium, phosphorus, potassium, sodium, chloride, sulfur and magnesium. The trace elements include copper, cobalt, chromium, fluorine, iodine, iron, manganese, molybdenum, nickel, selenium, silicon, tin, vanadium and zinc. Minerals may function as cofactors of enzymes, as components of organic compounds and as structural components of bones and teeth and are catalysts for many

**TABLE 1.17:** Major food sources, function, deficiency and toxicity symptoms of fat-soluble vitamins

| *Nutrient* | *Major food sources* | *Function* | *Deficiency symptoms* | *Toxicity symptoms* |
|---|---|---|---|---|
| Vitamin A | Breast milk, infant formula, liver, egg yolk, dark green and deep yellow vegetables and fruits | Preserves integrity of epithelial cells; formation of rhodopsin for vision in dim light; wound healing, growth, and normal immune function | Night blindness, dry eyes, poor bone growth, impaired resistance to infection, papillary hyperkeratosis of the skin | Fatigue; night sweats; vertigo; headache; dry and fissured skin; lips; hyper-pigmentation; retarded growth; bone pain; abdominal pain; vomiting; jaundice; hypercalcemia |
| Vitamin D | Egg yolk, liver, fatty fish, sunlight | Bone formation; promotes the absorption of calcium and phosphorus in the intestine | Rickets (symptoms: costo-chondral beading, epiphyseal enlargement, cranial bossing, bowed legs, persistently open anterior fontanelle) | Abnormally high blood calcium (hypercalcemia), retarded growth, vomiting, nephrocalcinosis |
| Vitamin E | Vegetable oils; liver; egg yolk; butter; green leafy vegetables; whole-grain breads, cereals, and other fortified or enriched grain products; wheat germ | Antioxidant in the tissues; coenzyme; neuromuscular function | Hemolytic anemia in the premature and newborn; hyporeflexia, and spino-cerebellar and retinal degeneration | Prolonged bleeding and clotting time. |
| Vitamin K | Vegetable oils, green leafy vegetables, pork, liver | Catalyzes prothrombin synthesis; required in the synthesis of other blood clotting factors | Prolonged bleeding and prothrombin time; hemorr-hagic manifestations | Possible hemolytic anemia; jaundice |

**TABLE 1.18:** Recommended vitamins intake for individuals

| *Age group (years)* | *A RDA(DV) (µg/d)* | *C RDA(DV) (µg/d)* | *D RDA(DV) (µg/d)* | *E RDA(DV) (µg/d)* | *K RDA(DV) (µg/d)* | *Thiamine RDA(DV) (mg/d)* | *Riboflavin RDA(DV) (mg/d)* | *Niacin RDA(DV) (mg/d)* | *$B_6$ RDA(DV) (mg/d)* | *$B_{12}$ RDA(DV) (µg/d)* | *Folic acid RDA(DV) (µg/d)* | *Biotin RDA(DV) (µg/d)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Males | | | | | | | | | | | | |
| 19–70 y | 900 (900) | 90 (90) | 15 (20) | 15 (15) | 120 (120) | 1.2 (1.2) | 1.3 (1.3) | 16 (16) | 1.3 (1.7) | 2.4 (2.4) | 400 (400) | 30 (30) |
| Females | | | | | | | | | | | | |
| 19–70 y | 700 (900) | 75 (90) | 15 (20) | 15 (15) | 90 (120) | 1.1 (1.2) | 1.1 (1.3) | 14 (16) | 1.3 (1.7) | 2.4 (2.4) | 400 (4000) | 30 (30) |
| Pregnancy | | | | | | | | | | | | |
| 19–50 y | 770 (1300) | 85 (90) | 15 (15) | 15 (19) | 90 (90) | 1.4 (1.4) | 1.4 (1.6) | 18 (18) | 1.9 (2) | 2.6 (2.8) | 600 (600) | 30 (35) |
| Lactation | | | | | | | | | | | | |
| 19–50 y | 1300 (1300) | 120 (120) | 15 (15) | 19 (19) | 90 (90) | 1.4 (1.4) | 1.6 (1.6) | 17 (18) | 2.0 (2) | 2.8 (2.8) | 500 (600) | 35 (35) |

**RDA-Recommended Daily Allowance *DV-Daily Value*

biological processes. Minerals may also participate in contraction and conduction of nerve impulses.

### *A. Macrominerals*

#### ☛ Calcium

Calcium is the most abundant cation in the human body. The body of an adult usually contains about 1200 g of calcium. More than 99% of the calcium is present in bones and teeth. The remaining 1% of total body calcium is necessary for a variety of metabolic processes including enzyme activation, hormone function, nerve transmission, muscle contraction, blood clotting and membrane transport.

**Sources:** Milk and milk products are the richest dietary sources of calcium. Lesser amounts of calcium are found in shellfish, egg yolk, canned sardines and salmon (with bones), soybeans and certain green leafy vegetables such as spinach, turnip and mustard greens, broccoli and kale. As a result of fortification, infant cereals are excellent sources of calcium. More recently, the fortification of foods such as orange juice and flour has become additional sources of calcium in the diet. In hard water areas, drinking water may also be a significant source.

**Deficiency:** Indian diets are poor in calcium. Calcium deficiency may occur in infants who are breast fed by mothers suffering from vitamin D deficiency. Calcium deficiency may occur in pregnant and lactating women. Low dietary calcium intake may produce rickets and osteomalacia. Severe calcium deficiency in children may also result in stunted growth, muscle weakness, parathyroid hyperplasia, hyperirritability, tetany and death.

#### ☛ Magnesium

The human body contains 20 to 28 g of magnesium. About 55% is present in bone while 27% is found in muscles. The remainder is found in the cells and extracellular fluids. Magnesium performs a vital role in the enzymatic reactions involving ATP (adenosine triphosphate). It is needed for the activation of thiokinases used in fatty acid oxidation as well as amino acid acyl synthetases. Magnesium is required for protein synthesis. It plays a role in maintenance of cell membranes and neuromuscular transmission.

**Sources:** Magnesium occurs widely in foods, particularly those of plant origin. Sources include green vegetables (magnesium is a component of chlorophyll), cereals, grains, meat, milk, seafood,

cocoa and nuts. Plasma magnesium concentrations range from 2 to 3 mg/dL.

**Deficiency:** Due to the abundance of magnesium in the food supply, primary magnesium deficiency is rare. Magnesium deficiency results in hypocalcemia and hypokalemia. Its deficiency affects the gastrointestinal, neuromuscular, cardiovascular and hematologic systems. Dysphagia, anemia, cardiac arrhythmias, tremors, weakness, failure to thrive and psychiatric disturbances may be present. Magnesium deficiency ultimately results in tachycardia, fibrillations, convulsions and death.

### ☛ Phosphorus

The phosphorus content of an adult man is approximately 700 g. About 80% of the body's phosphorus is found in bone as calcium phosphate and hydroxyapatite. In the bone the phosphorus to calcium ratio is 1 : 2. There is no free elemental phosphorus in the body. It is present as a constituent of various lipids, proteins, carbohydrates, enzymes, nucleic acid and ATP. In its ionic form, phosphorus serves to modify acid–base balance in the blood. Phosphorus acts as a cofactor in a number of enzyme systems involved in carbohydrate, protein and fat metabolism. Phosphorus is important as a component of phospholipids in cell membranes, lipoproteins, etc. and is involved in the renal excretion of hydrogen ions.

**Sources :** Protein foods of animal origin such as meat, fish, poultry and eggs are excellent sources of phosphorus. Milk and cheese are good sources of phosphorus.

**Deficiency:** Phosphorus deficiency has been reported in individuals consuming a prolonged and excessive intake of non-absorbable antacids, which bind dietary phosphorus preventing its absorption. Symptoms of phosphorus deficiency include weakness, anorexia, malaise and pain in the bones. Hemolytic anemia, granulocyte dysfunction, erythrocyte glycolysis, neurologic and psychiatric disorders, hypercalciuria and renal calculi may also result from phosphorus deficiency.

### ☛ Sodium and Potassium

Sodium and potassium are essential for normal growth and body functions. Sodium is the predominant extracellular electrolyte and potassium is the major intracellular cation. They are both involved in regulating water- and acid–base balance, in membrane permeability, nerve conduction and muscle action. Changes in

extracellular sodium concentration can affect arterial pressure, whereas changes in blood potassium concentration can affect cardiac performance.

**Sources:** Sodium and potassium are widely distributed in foods. Dietary sources of sodium include table salt (sodium chloride) and sodium-based food additives used in commercially processed and cured foods. Foods that have relatively high levels of naturally occurring sodium include milk and milk products, meat, fish (particularly ocean fish), seafood, poultry and eggs. Good sources of potassium are meat, poultry, fish, organ meats, milk and milk products and certain fruits and vegetables. High potassium fruits include avocado, banana, apricot, dried fruit, melons and oranges. Some high potassium vegetables are broccoli, brussels sprouts, parsnips, squash, potatoes, dry beans and peas.

**Deficiency:** Deficiency of both sodium and potassium under ordinary conditions is virtually unknown. However, in excessive sweat loss, severe vomiting and diarrhea, and in renal pathology; depletion of sodium can result in muscular cramps, mental confusion, apathy, anorexia and coma. Potassium depletion, which occurs when using diuretics, will cause muscular weakness, cardiac arrhythmia and mental confusion.

### *B. Trace elements*

#### ☛ Fluoride

Traces of fluoride are normally present in human tissues, notably in the bones, teeth, thyroid gland and skin. Fluoride is essential for the normal mineralization of bones and formation of dental enamel. The primary significance of this element in human nutrition is in the prevention of dental caries. Fluoride reduces the risk of tooth decay.

Drinking water should usually contain 1 ppm of fluorine. Less than 0.5 ppm of fluorine in water leads to dental carries, whereas excessive amounts lead to endemic fluoresces.

**Sources:** Most human adults ingest between 2 and 3 mg of fluorine daily. The chief source is usually drinking water, which, if it contains 1 ppm of fluorine, will supply 1 to 2 mg/day and will confer optimal protection against tooth decay. Compared with this source, the fluoride in foodstuffs is of a little importance. Very few foods contain more than 1 ppm; the exception is sea fish, which may contain relatively large amounts in the order of 5 to 10 ppm. Another significant source is tea, particularly Chinese tea, which

in the dry state, may contain as much as 100 ppm. In Britain and Australia, where tea is a popular beverage, the adult intake from this source may be as much as 1 mg daily.

Commercial baby foods generally contain less than 0.1 ppm fluoride. A significant source of fluoride for preschool children is fluoridated toothpaste. As the practice of tooth brushing becomes more widespread among preschool children, probably 75% of children may be using toothpaste by 18 months of age.

The Committee on Nutrition of the American Academy of Pediatrics recommends that infants in non-fluoridated areas (water less than 0.3 ppm) be given a fluoride supplement from about 2 weeks of age. The dosage depends on the concentration of fluoride in the local drinking water.

**Deficiency:** Mottling of teeth, deformity in bones (Hunch back).

### ☛ Iodine

Iodine is essential for all animals, including humans. Iodine is required as a component of the thyroid hormones thyroxine ($T_4$) and triiodothyronine ($T_3$). Thyroxine and triiodothyronine are required for normal energy metabolism, thermoregulation, intermediary metabolism, protein synthesis, reproduction, growth, physical and mental development, hematopoiesis and neuromuscular function. The adult human body contains 10–20 mg iodine. About 70–80% of the iodine is concentrated in the thyroid gland. The remainder is distributed throughout the body with higher concentrations occurring in the salivary and gastric glands as well as in the dense connective tissue.

**Sources:** The best sources of iodine are seafood and seaweed, which are of limited significance in Western diets. Meat, milk and eggs may also provide iodine; their iodine content is influenced by the iodine provided in the animal feed. Soils of coastal areas are rich in iodine. Food fortification with iodine has been most effective in the eradication of iodine deficiency. In Canada, table salt must contain 0.01% potassium iodide. In the United States, where non-iodized salt is also available, iodized salt contains 76 μg iodine per gram of salt. Since the introduction of iodized salt, goiter resulting from iodine deficiency has been virtually eliminated. Certain foods such as cabbage, rutabaga, and other members of the Brassica family contain *goitrogens,* which interfere with thyroid hormone synthesis. The uptake, synthesis and release of iodine by the thyroid gland is stimulated by thyroid stimulating hormone (TSH) released by the anterior pituitary gland.

**Deficiency:** Iodine deficiency is the most common cause of endemic goiter, abortion, infant death and cretinism in the world. Endemic goiter is one of the most prevalent nutritional deficiency problems that afflict millions of people in many parts of the world. Iodine deficiency results in enlargement of the thyroid gland (goiter). Severe iodine deficiency can produce myxedema, which is characterized by a dry, waxy type swelling, with abnormal deposits of mucoproteins under the skin.

**Toxicity:** Excessive dietary intake of iodine results in inhibition of thyroid hormone synthesis clinically known as the *Wolff-Chaikoff effect*. Generally, the body will adapt to the higher intake but in a few individuals the effect continues and the individual develops a goiter. *Hyperthyroidism* resulting from excessive iodine intake is characterized by increased basal metabolism, goiter and disturbances in the autonomic nervous systems causing hyperirritability and increased creatinine metabolism.

### ☛ Iron

Iron is an essential element in all cells of the body. It plays a key role in oxygen transport and cellular respiration as a constituent of hemoglobin, myoglobin and the enzymes—cytochrome oxidase, peroxidase and catalase. Iron in the cellular cytochrome system is required for energy metabolism. In the adult male, total body iron amounts to 3.5 to 5.0 g. In the premenopausal woman approximately 2.5 g of iron is normally present.

**Sources:** Good sources of iron include liver, heart, kidney, red meats, shell fish, egg yolk, dried beans, other legumes, dried fruits, nuts, green leafy vegetables, dark molasses and whole grain cereals. Iron-fortified cereal and cereal products such as flour, bread, infant- and breakfast cereals are also good sources when consumed as a dietary staple. Cow's milk is a poor source of iron as the iron in milk is poorly absorbed. Although breast milk supplies only about 0.5 to 0.8 mg of iron per day, the bioavailability of its iron is high. Normally, an infant born with an adequate store of iron will receive sufficient iron from breast milk in the first 4 to 6 months of life. Thereafter, additional sources such as iron-fortified infant cereals and other iron-rich baby foods are required.

**Deficiency:** Iron deficiency is one of the most prevalent nutritional problems in the world. Vegetable diets in India are mostly poor in iron content. The populations most susceptible to iron deficiency

problem are infants and young children, menstruating females, pregnant women and individuals on energy restricted diets and older people. Iron deficiency leads to anemia, i.e. reduction in the hemoglobin content of RBCs. Hemoglobin contains iron and hence deficiency of iron in diet causes a deficiency in hemoglobin content. Hemoglobin carries oxygen in the blood and therefore in iron deficiency anemia oxygen reduction in the blood causes sluggishness and fatigue and diminishes work and physical performance.

Iron deficiency is characterized by weakness, fatigue, poor work performance and changes in behavior.

**Toxicity:** Excessive iron ingestion may result in hemosiderosis or deposition of iron in the tissues without harmful effect. Prolonged excessive intake may result in hemochromatosis in which further iron storage results in tissue damage, particularly the liver and the pancreas. Hyperpigmentation of the skin is another feature of this disorder.

The recommended minerals intake for individuals are summarized in Table 1.19.

The requirement of nutrients for pregnant and lactating women is usually greater. Similarly these requirements also vary according to the age group like infants, children, adolescents and adults (Table 1.20).

**TABLE 1.19:** Recommended minerals intake for individuals

| *Age group* | *Ca (mg/day)* | *Mg (mg/day)* | *P (mg/day)* | *F (mg/day)* | *I (µg/day)* | *Fe (mg/day)* |
|---|---|---|---|---|---|---|
| **Children** | | | | | | |
| 1–3 y | 600 | 50 | 460 | 0.7 | 90 | 9 |
| 4–8 y | 600 | 70 | 500 | 1 | 90 | 13 |
| **Male** | | | | | | |
| 19–70 y | 600 | 340 | 700 | 4 | 150 | 17 |
| **Female** | | | | | | |
| 19–70 y | 600 | 310 | 700 | 3 | 150 | 21 |

Marketed preparations containing different minerals are given in Table 1.21.

**TABLE 1.20:** Major food sources, functions, deficiency and toxicity symptoms of minerals

| *Mineral* | *Major food sources* | *Function* | *Deficiency symptoms* | *Toxicity symptoms* |
|---|---|---|---|---|
| Calcium | Yogurt, cheese, some green leafy vegetables such as collards, kale mustard greens, and turnip greens, tofu (if made with calcium sulfate), salmon | Builds and maintains bones and teeth; essential in clotting of blood; influences transmission of ions across cell membranes; required in nerve transmission | Rickets; abnormal development of bones. | Excessive calcification of bone; calcification of soft tissue; hypercalcemia; vomiting; lethargy |
| Magnesium | Whole-grain breads, cereals, and other grain products; tofu; legumes; green vegetables | Required for many coenzyme oxidation-phosphorylation reactions, nerve impulse transmissions, and for muscle contraction | Muscle tremors; convulsions; irritability; tetany; hyper- or hypo-flexia | Diarrhea; transient hypocalcemia |
| Phosphorus | Cheese; egg yolk; meat; poultry; fish; whole-grain breads, cereals, and other grain products; legumes | Builds and maintains bones and teeth; component of nucleic acids, phospholipids; as coenzyme functions in energy metabolism; buffers intracellular fluid | Phosphate depletion unusual effects, renal, neuromuscular, skeletal systems as well as blood chemistries | Hypocalcemia (when parathyroid gland not fully functioning) |
| Sodium | Sodium chloride (table salt), abundant in most foods except fruit | Helps regulate acid–base equilibrium and osmotic pressure of body fluids; plays a role in normal muscle irritability and contractility; influences cell permeability | Nausea; cramps; vomiting; dizziness; apathy; exhaustion; possible respiratory failure | |

*Contd.*

**TABLE 1.20:** Major food sources, functions, deficiency and toxicity symptoms of minerals *(Contd.)*

| *Mineral* | *Major food sources* | *Function* | *Deficiency symptoms* | *Toxicity symptoms* |
|---|---|---|---|---|
| Potassium | Fruits especially orange juice, bananas, and dried fruits; yogurt; potatoes; meat; fish; poultry; soy products; vegetables | Helps regulate acid–base equilibrium and osmotic pressure of body fluids; influences muscle activity, especially cardiac muscle | Muscle weakness; decreased intestinal tone and distension; cardiac arrhythmias; respiratory failure | |
| Iron | Meat; liver; legumes; whole-grain breads, cereals, or fortified or enriched grain products; and dark green vegetables | Essential for the formation of hemoglobin and oxygen transport; increases resistance to infection; functions as part of enzymes involved in tissue respiration | Hypochromic microcytic anemia; malabsorption; irritability; anorexia; pallor; lethargy | Hemochromatosis; hemosiderosis. |
| Zinc | Meat; liver; egg yolk; oysters and other seafood; whole-grain breads, cereals, legumes | Component of many enzyme systems and insulin | Decreased wound healing, hypogonadism, mild anemia, decreased taste acuity, hair loss, diarrhea, growth failure, skin changes | Acute gastrointestinal upset; vomiting; sweating; dizziness; copper deficiency |
| Fluoride | Fluoridated water | Helps protect teeth against tooth decay; may minimize bone loss | Increased dental caries | Mottled, discolored teeth; possible increase in bone density; calcified muscle insertions and exotosis |

*Contd.*

**TABLE 1.20:** Major food sources, functions, deficiency and toxicity symptoms of minerals *(Contd.)*

| *Mineral* | *Major food sources* | *Function* | *Deficiency symptoms* | *Toxicity symptoms* |
|---|---|---|---|---|
| Iodine | Seafood, iodized salt | Helps regulate thyroid hormones; important in regulation of cellular oxidation and growth | Endemic goiter; depressed thyroid function; cretinism | Possible thyroid enlargement |
| Chloride | Sodium chloride (table salt) | Helps regulate acid–base equilibrium and osmotic pressure of body fluids; component of gastric juices | Usually accompanied by sodium depletion | |

**TABLE 1.21:** Marketed preparations containing different minerals

| *Marketed preparation* | *Formulation* | *Manufacturer* |
|---|---|---|
| Prenatal | Capsule | Wyeth Ltd. |
| Polybion | Injection | Merck Ltd. |
| Sandocal plus | Tablet | Novartis India Ltd. |
| Ossidos-t | Tablet | Wockhardt Ltd. |
| Macalvit | Syrup | Novartis India Ltd. |

Fortunately several marketed formulations containing multivitamins plus minerals are available, which meet the nutritional requirement of both, vitamins as well as minerals (Table 1.22). Such preparations are easier to administer and hence have better compliance. Drops and syrups are particularly useful in children.

**TABLE 1.22:** Marketed preparations containing multivitamins + minerals

| *Marketed preparation* | *Formulation* | *Manufacturer* |
|---|---|---|
| ABCD | Drop | Geneka Biotech |
| Kenimix | Syrup | Kendall Health Care |
| Menal | Tablet | Essay Bee Pharma |
| MMG | Syrup | Amro Pharma |
| Provit | Tablet | Hitech Formulation |

## MALNUTRITION

Malnutrition is a condition that results from nutrients deficiency or overconsumption. Malnutrition may affect any person, but following persons are at a higher risk:

1. Individuals with increased nutrient needs, especially children and pregnant or breastfeeding women.
2. Poor people having low socioeconomic status.
3. Older adults.
4. People with issues such as Crohn's disease or ulcerative colitis that affect nutrient absorption.

**Types of malnutrition include**

a. **Undernutrition:** This type of malnutrition results from not getting enough protein, calories or micronutrients including vitamins and minerals, especially iron, zinc, vitamin A and

iodine. It leads to low weight-for-height (wasting), low height for age (stunting) and low weight for age (underweight) and micronutrient deficiencies or insufficiencies (a lack of important vitamins and minerals). Undernutrition can increase your risk of death.

b. **Overnutrition:** Overconsumption of certain nutrients, such as protein, calories or fat, can also lead to overnutrition. This usually results in overweight or obesity and diet-related noncommunicable diseases (such as heart disease, stroke, Type 2 diabetes and cancer). Overnutrition results from the overconsumption of high calories food such as fried and sugary foods, tend to be high in calories and fat. Even micronutrient deficiencies can also occur with overnutrition in case where the persons take excessive calorie but not get enough vitamins and minerals at the same time.

Both types of malnutrition (undernutrition and overnutrition) can lead to health problems and nutrient deficiencies, if not addressed.

### Signs and Symptoms of Malnutrition

The signs and symptoms of malnutrition depend on the type of nutrition.

**Undernutrition** results from insufficient intake of nutrients in diet. Main symptoms of undernutrition are as follows:

1. Weight loss.
2. Loss of fat and muscle mass.
3. Hollow cheeks and sunken eyes.
4. A swollen stomach.
5. Dry hair and skin.
6. Delayed wound healing.
7. Fatigue.
8. Difficulty in concentrating.
9. Irritability.
10. Depression and anxiety.

Some of the most common nutrient deficiencies and their symptoms are given in Tables 1.16, 1.17 and 1.19.

### Assessment of Malnutrition

Various parameters to assess malnutrition include weight changes, body mass index (BMI) charts, blood tests for micronutrient status and physical exams. BMI is a measure of body fat based on height and weight that applies to adult person. People with a BMI under 18.5 are at risk of being malnourished and over 30 are suffering from obesity.

### Common Causes of Malnutrition

1. Lack of access to sufficient food.
2. Digestive problems.
3. Malabsorption of nutrients due to certain health conditions such as Crohn's disease, celiac disease and bacterial overgrowth in the intestine.
4. Excessive alcohol consumption.
5. Mental health disorders.
6. Poor mobility.

### Prevention of Malnutrition

1. Take iron, zinc and iodine pills as supplements.
2. Eat healthy food rich in carbohydrates, proteins, fats, vitamins, minerals and water.
3. Exercise daily.

### Treatments for Malnutrition

Treatment for malnutrition (undernutrition) depends on the underlying cause of malnutrition. Malnutrition can be treated at home with the support of dietitian or other qualified healthcare professional. In severe cases, treatment in hospital may be needed.

1. **Dietary changes and supplements:**
   a. Eating a healthy and balanced diet rich nutrients.
   b. Follow a tailored diet plan created with the help of dietitian.
   c. Eat 'fortified' foods that contain extra nutrients.
   d. Do snacking between meals.
   e. Take drinks full of calories are also helpful.
   f. Take extra nutrients in the form of supplements.
2. **Feeding tubes:** It is an alternative way of giving nutrients in case a person has dysphagia. In this case, feeding is done through nasogastric tube (tube passed through nose into stomach) or percutaneous endoscopic gastrostomy (PEG) tube (a tube placed directly into stomach or gut through the skin on tummy) or parenteral nutrition.
3. **Care and support services:** Some malnourished people with limited mobility need extra care and support that may be given by
   a. Home care visitors to shop for food or cook.
   b. Occupational therapy by an occupational therapist who can identify problems with daily activities and help to find solutions.

c. 'Meals on Wheels' or meals at home service by the local authority.
d. Speech and language therapy by a speech therapist who can teach exercises to help with swallowing problems and advice foods that are easy to swallow.

4. **Treating malnutrition in children:**
   a. Increased intake of foods high in energy and nutrients.
   b. Support for families to help them manage factors affecting the child's nutritional intake.
   c. Treatment for any underlying medical conditions causing malnutrition.
   d. Vitamin and mineral supplements.
   e. High-energy and protein nutritional supplements.
   f. Regular monitoring of treatment by keeping a watch over weight and height measurements of children.

## BALANCED DIET

The main purpose of food consumed by man is to provide energy for growth, maintenance of body functions, and work. This energy is obtained from carbohydrates, fats and protein.

A **diet** is the kind of food on which a person or group lives. A **balanced diet** is one that contains a variety of foods in such quantity and proportion as to meet the need for energy, amino acids, vitamins, minerals, fats, carbohydrates and other nutrients; to maintain health, vitality and general well-being. It also makes a small provision for extra nutrients to withstand short duration of leanness. A balanced diet is a means of protecting the population from nutritional deficiencies.

Any balanced diet should meet (i) the daily requirement of proteins (equivalent to 15–20% of daily energy intake), (ii) fat requirement (equivalent to 20–30% of daily energy intake), (iii) carbohydrates rich in natural fiber to constitute remaining food energy, and (iv) the requirement of micronutrients.

Dietary preference of individuals, groups, communities, etc. are variable according to local economy, culture, taste, habits, religions, customs, climatic conditions, etc. Balanced diet formulated by Indian Council of Medical Research (ICMR) is given in Table 1.23.

In the wake of the COVID-19 pandemic, people are now increasingly becoming aware of the importance of healthy food to increase immunity and to keep communicable diseases at

**TABLE 1.23:** Balanced diet formulated by ICMR

| *Food item (g)* | *Adult man (moderate work)* | *Adult woman (moderate work)* | *Boys (10–12 yr.)* | *Girls (10–12 yr.)* | *Children (1–3 yr.)* | *Children (10–12 yr.)* |
|---|---|---|---|---|---|---|
| Cereals | 520 | 440 | 420 | 380 | 175 | 270 |
| Pulses* | 50 | 45 | 45 | 45 | 35 | 35 |
| Leafy vegetables | 70 | 40 | 50 | 50 | 20 | 30 |
| Roots and Tubers | 60 | 50 | 30 | 30 | 10 | 20 |
| Milk | 200 | 150 | 250 | 250 | 300 | 250 |
| Oil and fat | 45 | 25 | 40 | 35 | 15 | 25 |
| Sugar or jaggery | 35 | 20 | 45 | 45 | 30 | 40 |

*In case of non-vegetarians 50% of pulses can be substituted by (i) one egg or 30 g of meat or fish, (ii) additional 5 g of fat or oil; 100% of pulses can be substituted by (i) two eggs or 50 g of meat or fish, (ii) additional 10 g of fat or oil.

bay. A balanced diet is considered as the key to prevent most of the nutritional deficiency diseases and viral/other infections (communicable diseases). In this context a community pharmacist can play a key role in educating the general public about different aspects of nutrition and health.

## SOCIOLOGY AND HEALTH

Social life affects morbidity and mortality rate, and vice versa. **Health sociology** examines the interaction between society and health. It discusses health and illness in relation to social institutions such as family, employment, and school. It limits its concern to the patient–practitioner relationship and the role of health professionals in society. The sociology of health and illness covers sociological pathology (causes of disease and illness), reasons for seeking particular types of medical aid, and patient compliance or noncompliance with medical regimes. There is a relationship between health and social factors as environmental conditions surrounding man and affects his health, traditions, lifestyle behaviors, self-treatment, values, customs and cultures. It

is concerned also with the distribution of healthcare services and in particular the inequalities in healthcare (health disparities).

### Sociocultural Factors Related to Health and Disease

Sociologists have demonstrated that social life has an impact on health, morbidity and mortality rate, and vice versa. There has been a long-term decline in mortality within industrialized societies, and on average, mortality rates are considerably higher in undeveloped societies than developed and developing. Spread of diseases is heavily influenced by the socioeconomic status of individuals, ethnic, traditions or beliefs, and other cultural factors. There are evident differences in patterns of health and illness across societies, over time, and within particular society types. Important socio-cultural factors are discussed below.

1. **Family:** Family has the greatest influence on a person's attitude towards health, and also influences a person's behavior choices relating to food and health. For example, in a house where parents eat fast food frequently their children are more likely to eat it even if they know it is not healthy. On the other hand, if a family is health conscious, then their children are more likely to prioritize healthy eating and exercise.
2. **Peers:** Human beings need each other for survival and attainment of both positive and negative aspects of life. The status of health in particular is usually a reflection of the effects of peers particularly in teenagers as they spend more of their free time with friends. Peer pressure can have negative and positive effects on health of a person. For example, if a person spends time with friends and peers who pay no attention to hygiene practices and have unhealthy habits like smoking, then the person is most likely to have negative outlook on the issue of cleanliness and healthy lifestyles. On the other hand, peers can improve health if your groups have lots of protective behaviors.
3. **Media:** The media is one of the sociocultural factors that determine health. The media plays a significant role in shaping health. This can be done through marketing campaigns or advertising through news articles or TV shows.
4. **Religion:** Religion influences our health more often in a positive manner. It can provide greater social support, enhanced self-esteem, and can reduce the negative effects of stress on health. Most religions also have rules, such as no intake of alcohol, no cigarette smoking and drug abuse, no premarital sex, no extramarital affairs that boost protective behaviors in

individuals and promote health. Conversely, religion can also be limiting. Certain religions put restrictions on clothes and social interactions, which can have negative effects on the health of the individual, e.g. a monk who takes a vow of silence and lives in isolation will lack social interaction. Religion can also limit one's choices in relation to healthcare, e.g. choice of vegetarian or non-vegetarian food.

5. **Culture:** Culture refers to an integrated pattern of belief, traditions, values, and behavior including traditional foods or social activities. It is the family, which passes the culture to next generations. A sense of connection and belonging to our culture may have a positive influence in improving the social dimension of health. Many cultures have traditional food that may affect health. The Mediterranean cultures have a diet rich in healthy fats and vegetables leading to lower rates of cardiovascular diseases. They have a high value for family and community increasing social health. The Japanese have good combination of very low intake of meat and high intake of fresh vegetables that impacts health positively.

   Each culture has its own preferred method of treating disease and fixing the body. For examples, traditional Chinese medicine uses herbs and acupuncture as their main medicinal treatments, while many western countries like Australia and America utilize the pharmacological (drug) method.
6. **Race and ethnicity:** There is strong connection between socio-cultural and socioeconomic factors that may influence health status. Racial discrimination leads to disparities in income, education, neighborhood poverty and access to healthcare. Racial and ethnic minority groups experience more problems in gaining access to health service and have poorer health and shorter life expectancy compared to the others.

## Impact of Urbanization on Health and Disease

Urbanization refers to the population shift from rural areas to urban areas. More than 50% of the world's population lives in urban area. The world is rapidly urbanizing with significant changes in living standards, lifestyles, social behavior and health. Although, urban living continues to offer many opportunities, including potential access to better healthcare, yet it introduces new hazards and worsens the health status of the populations. Health challenges that are mainly evident in cities relate to water, air, environment, social violence, substandard housing, crowding, inadequate sanitation

and solid waste disposal services, vector-borne diseases, industrial waste, increased motor vehicle traffic, stress associated with poverty and unemployment, lifestyles including unhealthy diets and physical inactivity, harmful use of alcohol. They all directly place human health at risk.

### Emerging Health Problems

Various emerging health problems associated with urbanization are discussed below:

1. **Environmental:** Rapid urban growth is often associated with environmental degradation, e.g. air, noise, and water pollution; food safety; ozone depletion; natural resource depletion; and climate changes. These environmental problems can cause or exacerbate many other problems such as:
   a. Climate changes can cause deaths from extreme heat or cold.
   b. Lead poisoning lead to developmental and behavior problems.
   c. Noise can cause sleep disturbances and hence poor performance at work and in school.
   d. Poor air quality can trigger allergies, emphysema, asthma, heart disease, chronic respiratory disease, lung cancer, and even damage to other vital organs.
   e. Second-hand smoke and exposure to carcinogens may cause cancer.
   f. Unclean water supply can cause and transmit waterborne diseases, e.g. diarrhea.
2. **Housing:** Rapid growth of urban centers has led to substandard housing, overcrowding, insufficient and poor water supply and poor sanitation systems. The physical, mental, and social health is mainly affected by living conditions, e.g. allergies, outbreaks of diseases transmitted through respiratory and feco-oral route, respiratory diseases, cardiovascular effects, injuries, depression, anxiety, stress, etc.
3. **Social:** With social issues such as lack of resources, poverty, unemployment, and lack of education and social services, many social problems can evolve, e.g. crime, violence, drug abuse, accidents, high school drop-out rates. Social problems have an impact on the health also. Health problems caused due to the social problems include cirrhosis of the liver caused by alcohol consumption, malnutrition caused by poverty, suicide

caused by lack of mental health services, injury caused by drugs or stress.

4. **Lifestyle:** Many of the health problems like cardiovascular diseases, respiratory diseases, cancer, stroke, obesity, and diabetes today are related to lifestyle factors like decrease in activity, intake of processed food high in calories and low in nutrition. The rising trends of non-communicable diseases are a consequence of the several factors such as illiteracy, lack of access to healthcare, or to social services, poverty, overcrowding, and stress. Many of the health problems can be prevented by education, social services programs, by dietary transitions and exercise.

## POVERTY AND HEALTH

The prevalence of poverty is an important public health issue worldwide. Poverty is general scarcity or lack of a certain amount of material belongings or money. Basically, it is the incapability to acquire the basic goods like food and clothes, to go to a school or clinic, and not having the assets to support one's living.

Poverty is a major cause of ill health. Poor people have low levels of health and education and die younger than those who have more money. They have inadequate physical security, higher than average child and maternal mortality, higher levels of disease, more limited access to healthcare, more susceptibility to violence and social protection. They live in environments with poor hygiene and unsafe water. Due to low level of education, they lack information on appropriate health-promoting practices and lack basic capacity to participate effectively in society.

Poor people have low body resistance. They are more prone to diseases, whether the benchmark is mortality, the prevalence of acute or chronic diseases or mental health. They normally suffer from nutritional deficiency diseases as they cannot afford to buy sufficient quantities of quality food. Due to the financial crisis the poor cannot afford the costs of seeking healthcare, which include consultations, diagnostic tests, medicine, etc. Sometimes, poor families borrow money at high interest rates, sell their assets to cover medical expenses or become indebted to the community.

Disability, chronic diseases such as arthritis, rheumatism, diabetes, heart problems, cancer, and hypertension are much more prevalent among individuals with low income. Similarly, income-based disparities are found among children and mothers. Almost

half of children who live in poverty have mothers with symptoms of depression, because of the stresses of raising a family. Most of the children living in poverty have cavities. This high rate of cavities may be due to parents' lack of awareness about oral healthcare as well as high cost of dental care for their children.

For poor people especially, health is also a crucially important economic asset. Their livelihoods depend on it. When a poor or socially vulnerable person becomes ill or injured, the entire household is trapped in a downward spiral of lost income. This is due to the considerable loss of income both of the breadwinner and of family members who stop working or attending school to take care of sick relative.

**Poverty alleviation:** WHO supports countries to design and implement 'pro-poor' health policies, that is, health policies that prioritize and respond to the needs of poor people. Health and poverty issues differ markedly from country to country. WHO ensures that the health perspective is reflected in poverty reduction strategies, medium-term expenditure frameworks, and helps to develop sector-wide approaches. Various sets of the following measures have been taken to permanently raise people out of poverty in India.

1. **Income assistance:**
   - Mahatma Gandhi National Rural Employment
   - The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)
   - National Rural Livelihood Mission (NRLM)
   - Swarna Jayanti Sahri Rojgar Yojana (SJSRY).
2. **Food assistance:**
   - National Food for Work Programme
   - Antyodaya Anna Yojana
   - Annapurna Scheme for aged
   - National School Lunch Program (NSLP).
3. **Social security assistance:**
   - Rashtriya Swasthya Bima Yojana (RSBY)
   - Indira Gandhi National Old Age Pension Scheme (IGNOAPS).
4. **Housing assistance:**
   - Indira Awas Yojana.
5. **Universal healthcare:**
   - Rashtriya Swasthya Bima Yojana (RSBY)
   - Indira Gandhi National Old Age Pension Scheme (IGNOAPS)
   - Jan Dhan Yojana.

## HYGIENE AND HEALTH

The world 'hygiene' is derived from **Hygeia,** the goddess of health, cleanliness and sanitation**.** In Greek mythology, she is represented as a beautiful woman holding a bowl in her hand from which a serpent is drinking. The serpent testifies the art of healing, which symbol is retained even today.

**Hygiene** may be defined as 'the science of health and embraces all factors, which contribute to healthful living'. It refers to conditions and practices that help in maintaining good health and in preventing the spread of the diseases.

As hygiene and health go hand in hand and are interrelated, so it becomes vital to be careful about hygiene to keep ourselves free from diseases. There are various terms used in context with the public health like personal hygiene, sleep hygiene, mental hygiene, dental hygiene, and occupational hygiene.

In fact, most of the new-world communicable diseases like dengue, bird flu and swine flu have been attributed to lack of hygiene and healthy environment. Person to person transmission of these diseases can be prevented by various measures like covering dustbins and all the drains, preventing water to stagnate to prevent breeding of vectors like flies and mosquitoes. Sewer lines should be properly connected with sewage treatment plants so as to prevent contamination of drinking water with feces as it may cause number of diseases.

Person-to-person transmission of most of the virus infections like COVID-19 (coronavirus disease) takes place both directly and indirectly through hands. Transmission can be prevented by practicing good personal hygiene such as covering the face with mask, washing hands frequently with soap for 20 seconds especially before preparing or eating food, after cleaning vegetables or fruits, stroking pet/animals, covering mouth with a tissue or cloth while coughing or sneezing. People with diabetes or other chronic illnesses are more prone to infections, hence they should follow personal hygiene very strictly.

### Personal Hygiene and Healthcare

Personal hygiene is an essential part of maintaining good health. One should adopt the following measures to maintain good personal hygiene:

1. Take bath regularly once or twice everyday.
2. Brush the teeth after each meal as dental hygiene prevents gum disease and tooth decay.

3. Wash the hair with soap or shampoo at least once a week. Regular cleaning and combing keeps hair free from lice.
4. Regularly trim the nails.
5. Wash hands with soap after going to the toilet to make them germ free.
6. Wash hands with soap before preparing and/or eating food. Disease-causing germs may get onto the hands and under the nails during normal daily activities. These germs are to be washed off before preparing food or eating as they may get onto the food and may cause sickness.
7. Change into clean clothes as often as possible. Dirty clothes should be washed with laundry soap before wearing them again as they may cause very serious skin disorders.
8. Dry washed clothes in the sun. The sun's ultraviolet rays will kill some disease-causing germs and parasites.
9. Cover the nose and mouth with a tissue when coughing or sneezing. Otherwise, droplets of liquid containing germs from the nose and mouth will spread in the air and will transmit the infection.
10. Wash eyes daily with tap water.
11. Clean nose at regular intervals.
12. Genital areas are most prone to infections and bacterial attacks. These areas should always be kept extremely clean.

### Avoidable Habits

Bad habits affect mental, physical, and social health. Following are some bad habits to quit right away:

1. Avoid nail biting as it is unhygienic and leads to dental problems like malocclusion of the anterior teeth, and stomach problems.
2. Quit smoking as it causes premature skin ageing, respiratory problems, lung cancer, yellowing of teeth, and bad breath.
3. Avoid intake of alcohol as it may cause brain problems, cardiomyopathy, high blood pressure, arrhythmias, stroke, fatty liver, hepatitis, fibrosis, cirrhosis, pancreatitis, cancer, etc.
4. Avoid eating *junk food*.
5. Avoid self-medication.

A community pharmacist having adequate knowledge of concepts of health and disease would be useful to the country.