



CHAPTER – 15

Human Diseases

According to the World Health Organization (WHO), health is a state of complete physical, mental and social well-being. A person without any physical or mental disease or infirmity is said to be healthy. A healthy person has the ability to lead a socially and economically productive life.

The biological term for health is *homeostasis*, which is an organism's ability to efficiently respond to destabilising effects of various internal as well as external factors and effectively restore and sustain a state of balance in the body. In other words, the term 'health' is used to describe a person's overall state of physical well-being.

There are four general determinants of health, viz. human biology, environment, lifestyle and healthcare services.. Thus, health is maintained and improved not only through the advancement and application of health science, but also through the efforts and intelligent lifestyle choices of the individual.

Leading a hygienic lifestyle, eating a nutritious diet, exercising to reduce body fat and attain physical fitness, managing stress, and avoiding smoking, consumption of alcohol and other forms of substance abuse are simple ways of one's lifestyle that generally improve one's health.

Mental health is a concept that refers to an individual's emotional and psychological well-being. It is the state in which an individual is able to use his or her cognitive and emotional capabilities, function in society, and meet the ordinary demands of everyday life.

15.1 HEALTH AND ITS FAILURE

Overall health of a person may become degraded due to many reasons, such as lack of adequate nutritious food, lack of physical exercise, unfavorable environmental conditions, diseases, etc. Out of these, diseases represent the most important reason that degrades the health of a person.

15.2 DISEASES AND ITS CAUSES

A disease is an abnormal condition of an organism that impairs bodily functions. In human beings, "disease" is often used more broadly to refer to any condition that causes discomfort, abnormal functioning of the body, distress, social problems, and sometimes, death to the person afflicted, or similar problems for those in contact with the person. In this broader sense, it sometimes includes injuries, disabilities, disorders, syndromes, infections, deviant behaviours, and atypical variations of structure and function. While many diseases are biological processes with observable alterations of organ function or structure, others primarily involve alterations of behaviour.

15.2.1 Causes of disease

A number of different factors intrinsic or extrinsic to a person can cause disease. Examples of intrinsic factors are genetic defects or nutritional deficiencies. Environ-

mental exposure, such as to second hand smoke, infection with a disease-causing microorganism, etc. are examples of extrinsic factors. Many diseases result from a combination of intrinsic and extrinsic factors. For many diseases a cause cannot be identified.

The extrinsic factors that cause diseases can be broadly classified into categories like social, psychological, environmental factors. Environmental factors include toxic chemicals (e.g. acetaldehyde in cigarette smoke, pesticide residues in water, etc.) and infectious microorganisms (e.g. *Bacillus tuberculosis*, smallpox, poliovirus).

Pathology is the study of diseases. The subject of systematic classification of diseases is referred to as *nosology*. Its cause is referred as its *etiology*. The broader body of knowledge about human diseases and their treatments is medicine. Many similar (and a few of the same) conditions or processes can affect non-human animals (wild or domestic). The study of diseases affecting animals is *veterinary medicine*.

15.2.2 Symptoms

A symptom is a sensation or change in health function experienced by a patient. Symptoms may be loosely classified as strong, mild or weak. It is somewhat different to a sign, which is the evidence of the presence of a disease or disorder. Examples of symptoms are fatigue or tiredness, pain, nausea etc. In contrast, elevated blood pressure, or abnormal appearance of the retina, would be a medical sign indicating the nature of the disease.

A symptom may also be a physical condition which indicates a particular illness or disorder. An example of a symptom in this sense of the word would be a rash. However, correctly speaking, this is known as a sign, as would any indication detectable by a person other than the sufferer without any verbal information from the patient.

A symptom can be defined as any feature which is noticed by the patient. A sign is noticed by the doctor or others. It is not necessarily the nature of the sign or symptom which defines it, but who observes it. Clearly then, the same feature may be noticed by both doctor and patient, and so is at once both a sign and a symptom. Some features, such as pain, can only be symptoms. A doctor cannot feel a patient's pain (unless he is the patient!). Others can only be signs, such as a blood cell count measured by a doctor or in a clinical laboratory.

Medical usage sometimes distinguishes a disease, which has a known specific cause or causes (or etiology), from a *syndrome*, which is a collection of signs or symptoms that occur together. However, many conditions have been identified, yet continue to be referred to as syndromes. Furthermore, numerous conditions of unknown etiology are referred to as diseases in many contexts.

15.3 INFECTIOUS DISEASE

An **infectious disease** is a clinically evident disease resulting from infection with pathogenic microbial agents, including virus, bacteria, fungi, protozoa, multicellular parasites, and aberrant proteins known as prions. These pathogens are able to cause disease in animals and plants.

Infectious diseases are usually known as **contagious diseases** (also called communicable diseases) due to their potentiality of transmission from one person or species to another. Transmission of an infectious disease may occur through one or more of diverse pathways including physical contact with infected individuals. These infecting agents may also be transmitted through liquids, food, body fluids, contaminated objects, airborne inhalation, or through disease-spreading organisms called vectors.

15.4 SOME COMMON DISEASES SPREAD BY MICROBES

15.4.1 DIARRHOEA

Diarrhoea is a common disease characterized by an increase in the frequency of bowel movements with a decrease in the form of stool (greater looseness of stool). Generally, it is a condition during which the patient passes a liquid or watery stool in an increased frequency than normal.

15.4.2 What are the causes of diarrhoea?

The looseness of stool in diarrhoea is caused by increased water in the stool. During normal digestion, food is kept liquid by the secretion of large amounts of water by the stomach, upper small intestine, pancreas, and gallbladder. Food that is not digested reaches the lower small intestine and colon in liquid form. The lower small intestine and particularly the colon absorb the water, turning the undigested food into a more-or-less solid form. Increased amounts of water in stool can occur if the stomach and/or small intestine secrete too much fluid, the distal small intestine and colon do not absorb enough water, or the undigested, liquid food passes too quickly through the small intestine and colon for them to remove enough water.

Some pathogenic viruses, bacteria and parasites cause increased secretion of fluid, either by invading and inflaming the lining of the small intestine. Inflammation stimulates the lining to secrete fluid. These pathogens may also produce toxins (chemicals) that also stimulate the lining to secrete fluid but without causing inflammation. This can increase the rapidity with which food passes through the intestines, reducing the time that is available for absorbing water.

15.4.3 Acute and chronic diarrhoea

Diarrhoea generally is divided into two types, acute and chronic. Acute diarrhoea lasts a few days or up to a week. Chronic diarrhoea can be last more than three weeks. It is important to distinguish between acute and chronic diarrhea because they usually have different causes, require different diagnostic tests, and require different treatment.

Acute diarrhoea

The most common cause of acute diarrhoea is infection by microbes (viral, bacterial, and parasitic protozoan pathogens). Bacterial food poisoning can also cause acute diarrhoea. A third important cause of acute diarrhoea is medications, such as intake of certain antibiotics, etc.

Viral gastroenteritis: Viral gastroenteritis or viral infection of the stomach and the

small intestine is the most common cause of acute diarrhoea worldwide. Symptoms of viral gastroenteritis are nausea, vomiting, abdominal cramps, and diarrhoea that typically last only 48-72 hrs. The patients with viral gastroenteritis usually do not have blood or pus in their stools and may have little fever.

Viral gastroenteritis may occur in a single individual (sporadic form) or among groups of individuals (in an epidemic form). Sporadic diarrhoea probably is caused by several different viruses and may be spread by person-to-person contact. The most common cause of epidemic diarrhoea (e.g., on cruise ships) is calciviruses (Astroviridae). The calciviruses are transmitted by food that is contaminated by sick food-handlers or by person-to-person contact.

Food poisoning: Food poisoning is a brief illness that is caused by toxins produced by bacteria. The toxins cause abdominal pain (cramps) and vomiting and also cause the small intestine to secrete large amounts of water that leads to diarrhoea.

Staphylococcus aureus is an example of a bacterium that produces toxins in food before it is eaten. Typically, food items such as salad, meat or sandwiches with creamy filling (mayonnaise), etc. become contaminated with *Staphylococcus* if left un-refrigerated at room temperature overnight. The bacteria multiply in the food and produce toxins. *Clostridium perfringens* is an example of a bacterium that multiplies in food (usually canned food), and produces toxins in the small intestine after the contaminated food is eaten.

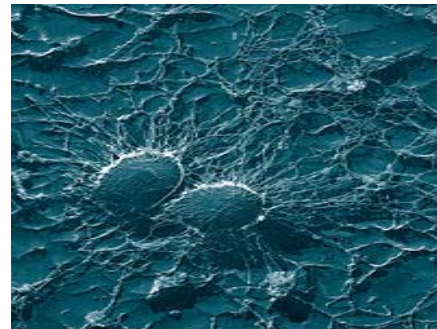


Fig. 15.1. *Staphylococcus*

Traveller's diarrhoea: *Escherichia coli* is a bacterium which is a normal inhabitant of the small intestine and colon. Many strains of *E. coli* are non-pathogenic, i.e. they do not cause disease in the intestines.

Certain strains of *E. coli*, however, are pathogenic i.e. they can cause disease in the small intestine and colon. These pathogenic strains of *E. coli* cause diarrhoea either by producing toxins or by invading and inflaming the lining of the small intestine and the colon, thus causing enterocolitis. Traveller's diarrhoea usually is caused by a pathogenic strain of *E. coli* that produces a diarrhoea-inducing toxin.



Fig. 15.2. *Escherichia coli*

Tourists visiting foreign countries with warm climates and poor sanitation can acquire this bacteria by eating contaminated foods such as fruits, vegetables, raw meat, water, and ice cubes. Toxins produced by the bacteria cause the sudden onset of diarrhoea, abdominal cramps, nausea, and sometimes vomiting. These symptoms usually occur 3-7 days after which they generally subside within 3 days.

Bacterial enterocolitis: Disease-causing bacteria usually invade the small intestines and colon and cause enterocolitis (inflammation of the small intestine and

colon). Bacterial enterocolitis is characterized by signs of inflammation (blood or pus in the stool, fever) and abdominal pain and diarrhoea. *Campylobacter jejuni* is the most common bacterium that causes acute enterocolitis. Other bacteria that cause enterocolitis include *Shigella*, *Salmonella*, and pathogenic *E. coli*. These bacteria usually are acquired by drinking contaminated water or eating contaminated foods such as vegetables, poultry, and dairy products.

15.4.4 Complications of diarrhoea

Dehydration occurs when there is excessive loss of fluids and minerals (electrolytes) from the body due to diarrhoea, with or without vomiting. Dehydration is common among adult patients with acute diarrhoea who have large amounts of stool, particularly when the intake of fluids is limited by lethargy or is associated with nausea and vomiting. It is common in infants and young children who develop viral gastroenteritis or bacterial infection. Patients with mild dehydration may experience only thirst and dry mouth. Patients with moderate to severe dehydration faint on standing due to a reduced volume of blood that lowers blood pressure, a diminished urine output, severe weakness, kidney failure, confusion, acidosis (too much acid in the blood), and coma.

Electrolytes (minerals) are lost with water when diarrhoea is prolonged or severe, and electrolyte deficiencies may occur. The most common mineral deficiencies occur with sodium and potassium.

Finally, there may be irritation of the anus due to the frequent passage of watery stool containing irritating substances.

15.4.5 When should the doctor be called for diarrhoea?

Most episodes of diarrhoea are mild and of short duration and do not require the attention of a doctor. The doctor should be consulted when there is:

- i. High fever (temperature greater than 101 F);
- ii. Moderate or severe abdominal pain or tenderness;
- iii. Bloody diarrhoea that suggests severe intestinal inflammation;
- iv. Diarrhoea in persons with serious underlying illness, for example, diabetes, heart disease, and AIDS;
- v. Severe diarrhoea that shows no improvement after 48 hours;
- vi. Moderate or severe dehydration;
- vi. Prolonged vomiting that prevents intake of fluids orally;
- vii. Acute diarrhoea in pregnant women because of health concern of the foetus;
- viii. Diarrhoea that occurs during or immediately after completing a course of antibiotics;
- ix. Diarrhoea after returning from journey to a place with poor sanitation;
- x. Diarrhoea that develops in patients with chronic intestinal diseases such as colitis;
- xi. Acute diarrhoea in an infant or young child.

15.4.6 How can dehydration be prevented and treated?

Oral rehydration solutions (ORS) are liquids that contain a carbohydrate (glucose or rice syrup) and electrolytes (sodium, potassium, chloride, and citrate or bicarbonate). Originally, the World Health Organization (WHO) developed the WHO-ORS to rapidly rehydrate victims of the severe diarrhoeal illness cholera. The WHO-ORS solution contains glucose and electrolytes. The glucose in the solution is important because it forces the small intestine to quickly absorb the fluid and the electrolytes. The purpose of the electrolytes in the solution is the prevention and treatment of electrolyte deficiencies. Presently, convenient premixed commercial ORS products that are similar to the WHO-ORS are available for rehydration and prevention of dehydration. Most of the commercially available ORS products contain glucose.

15.4.7 How is diarrhoea treated?

Antibiotics: Metronidazole is a very effective anti-diarrhoea medication. It is an effective antibiotic against certain protozoal infections, especially *Giardia*. A common use of this medication would be the treatment of colitis, which may or may not be caused by inflammatory bowel disease. However, antibiotics, many of which are available, should be taken only with a doctor's advice.

Absorbents: Absorbents are compounds that absorb water. Absorbents that are taken orally bind water molecules in the small intestine and colon and make diarrhoeal stools less watery. They also may bind toxic chemicals produced by bacteria that cause the small intestine to secrete fluid.

Anti-motility medications: Anti-motility medications are drugs that relax the muscles of the small intestine and/or the colon. Relaxation results in slower flow of intestinal contents. Slower flow allows more time for water to be absorbed from the intestine and colon, reduces the water content of stool. Cramps, due to spasm of the intestinal muscles, also are relieved by the muscular relaxation. Absorbents and anti-motility medications should not be used without a doctor's advice. These medications should not be used in children younger than two years of age.

15.5 TYPHOID or ENTERIC FEVER

Typhoid, or Enteric fever is a disease caused by infection of *Salmonella typhi* leads. This disease is characterized by the sudden onset of a sustained high fever, severe headache, nausea, and loss of appetite. Other symptoms include constipation or diarrhoea, enlargement of the spleen, possible development of meningitis, and general malaise in most cases. If not treated timely, typhoid fever results in mortality rates ranging from 12-30% while timely treatment can bring 99% survival.

15.5.1 Infection with *Salmonella typhi*

Salmonella typhi is a Gram negative pathogenic bacterium. The infection of humans by *Salmonella typhi* occurs through the faecal-oral route from infected individuals to healthy ones. Poor hygiene of patients can lead to secondary infection, as well as consumption of snails from polluted water bodies. The most common source of infection, however, is drinking water contaminated by urine and faeces of

infected individuals. Once ingested, the organisms multiply in the small intestine over the period of 1-3 weeks. Then, the bacteria move across the intestinal wall, and spread to other organ systems and tissues. The innate defence mechanisms of the host are weakened and is not able to prevent infection.

Infection of healthy persons with *S. typhi* has only been shown to occur often from carrier individuals. 2-5% of previously infected individuals become chronic carriers who show no signs of disease, but actively shed viable organisms capable of infecting others. A good example is “Typhoid” **Mary Mallon**, who was a food handler responsible for infecting at least 78 people and killing 5 of them. These highly infectious carriers pose a great risk to public health due to their lack of disease-related symptoms.



Fig.15.3 *Salmonella typhi*

The damage caused by typhoid fever is reversible and limited if treatment is started early. This leads to a mortality rate of less than 1% among treated individuals who have an antibiotic-susceptible strain of *S. typhi*, making the outcome and prognosis for patients a positive one.

15.5.2 Symptoms

Typhoid fever is characterized by the following symptoms:

1. Continuous fever as high as 40°C (104°F) with profuse sweating,
2. Rosy spots on the lower chest and abdomen,
3. Slow heart beat,
4. Delirium with Headache and Cough.
5. Bleeding from the nostrils,
6. Abdominal pain, gastroenteritis, diarrhoea and dehydration

Widal test

The Widal test is a serological test for Enteric fever introduced by Georges-F. Widal, a French physician. It is a demonstration of *Salmonella* agglutinating antibodies in the blood. It is used as a presumptive diagnostic test for Enteric fever.

15.5.3 Prevention:

A vaccination for typhoid fever is available. However, it can lose its effectiveness after several years, so a booster vaccination may be necessary.

Other preventives for typhoid fever are:

1. Using water that has been boiled or chemically disinfected for:
 - a. drinking or preparing beverages such as tea or coffee
 - b. brushing teeth
 - c. washing face and hands

- d. washing fruits and vegetables
 - e. washing utensils and food preparation equipments
 - f. washing the surface of tins, cans, and bottles that contain food or beverages
2. Eating food or drinking beverages only from hygienic sources
 3. Any raw food such as fruits, vegetables, salad greens, unpasteurized milk and milk products, raw meat, shellfish, etc. could be contaminated and should be avoided during epidemics.

Taking antibiotics is not a preventive for typhoid fever.

It is important to remember that the danger of typhoid fever does not end when symptoms disappear. You could still be carrying *Salmonella typhi* and the illness could return, or you could pass the disease to other people. People who have typhoid fever should:

- take the prescribed antibiotics.
- wash hands after using the bathroom.
- have a series of stool cultures - to ensure that the *Salmonella typhi* bacteria are no longer present.

15.6 MALARIA

Malaria is one of the most common infectious diseases and an enormous public-health problem. The disease is caused by protozoan parasites of the genus *Plasmodium*. The most serious forms of the disease are caused by *Plasmodium falciparum* and *Plasmodium vivax*, but other related species can also infect humans. These human-pathogenic *Plasmodium* species are usually referred to as malarial parasites.

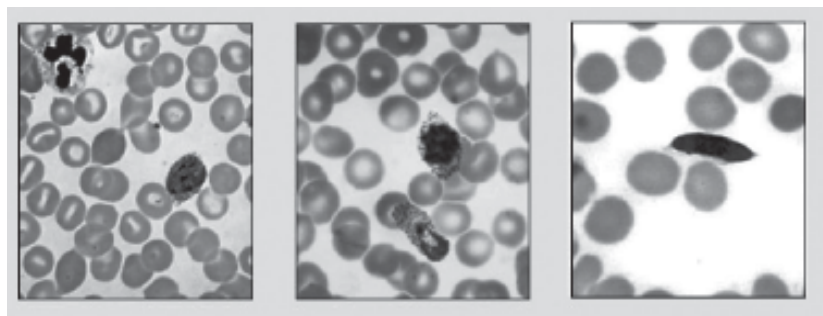


Fig. 15.4 *Plasmodium falciparum* in blood

Malaria parasites are transmitted by female *Anopheles* mosquitoes. The parasites multiply within red blood cells, causing symptoms like anaemia, light headedness, shortness of breath, etc. Other general symptoms are fever, chills, nausea, flu-like illness, and in severe cases, coma and death. Malaria transmission can be reduced by preventing mosquito bites with mosquito nets and insect repellents, or by mosquito control measures such as spraying insecticides inside houses and draining stagnant water where mosquitoes lay their eggs.

Presently, no vaccine is available for malaria; preventative drugs must be taken continuously to reduce the risk of infection. Prophylactic drug treatments are often too expensive for most people living in endemic areas. Malaria infections are treated through the use of antimalarial drugs, such as quinine or artemisinin derivatives, although drug resistance is increasingly common.

15.6 1 Symptoms

Symptoms of malaria include fever, shivering, arthralgia (joint pain), vomiting, anaemia caused by haemolysis (destruction of blood cells), haemoglobinuria, and convulsions. There may be the feeling of tingling in the skin, particularly with malaria caused by *P. falciparum*. The classical symptom of malaria is cyclical occurrence of sudden coldness followed by rigor and then fever and sweating lasting four to six hours. The fever occurs every two days in *P. vivax* and *P. ovale* infections, while every three for *P. malariae*. *P. falciparum* infected patients can have recurrent fever every 36-48 hours or a less pronounced and almost continuous fever. Children with malaria frequently exhibit abnormal posturing, a sign indicating severe brain damage. Malaria has been found to cause cognitive impairments, especially in children. It causes widespread anaemia during a period of rapid brain development and also direct brain damage. This neurologic damage results from cerebral malaria to which children are more vulnerable.

Severe malaria is almost exclusively caused by *P. falciparum* infection and usually arises 6-14 days after infection. Consequences of severe malaria include coma and death if untreated. Young children and pregnant women are especially vulnerable. Enlarged spleen, severe headache, cerebral ischemia, enlarged liver, hypoglycemia, and bloody urine with renal failure may occur. Severe malaria can progress fast and cause death within hours or days. In the most severe cases of the disease fatality rates can exceed 20%, even with intensive care and treatment. In endemic areas, treatment is often less satisfactory and the overall fatality rate for all cases of malaria can be as high as one in ten.

Chronic malaria is caused both by *P. vivax* and *P. ovale*, but not in *P. falciparum*. Here, the disease can relapse months or years after exposure, due to the presence of latent parasites in the liver.

15.6. 2 Prevention and disease control

Female *Anopheles* mosquito is a vector of malaria and mosquito control is a very effective way of reducing the incidence of malaria. Methods used to prevent the spread of disease, or to protect individuals in areas where malaria is endemic, include prophylactic drugs, mosquito eradication and the prevention of mosquito bites. There is currently no vaccine that will prevent malaria, but this is an active field of research.

Efforts to eradicate malaria by eliminating mosquitoes have been successful in some areas. Malaria was once common in the United States and southern Europe, but the draining of wetland breeding grounds and better sanitation, in conjunction with the monitoring and treatment of infected humans, eliminated it from affluent regions.

Several drugs, most of which are also used for treatment of malaria, can be taken preventively. Generally, these drugs are taken daily or weekly, at a lower dose than would be used for treatment of a person who had actually contracted the disease.

Quinine was used starting in the seventeenth century as a prophylactic against malaria. The development of more effective alternatives such as quinacrine, chloroquine, and primaquine in the twentieth century reduced the reliance on quinine. Today, quinine is still used to treat chloroquine resistant *Plasmodium falciparum*, as well as severe and cerebral stages of malaria, but is not generally used for prophylaxis.

Mosquito nets help keep mosquitoes away from people, and thus greatly reduce the infection and transmission of malaria. The nets are not a perfect barrier, so they are often treated with an insecticide designed to kill the mosquito before it has time to search for a way past the net. Since the *Anopheles* mosquitoes feed at night, the preferred method is to hang a large "bed net" above the center of a bed such that it drapes down and covers the bed completely.

The distribution of mosquito nets impregnated with insecticide (often permethrin or deltamethrin) has been shown to be an extremely effective method of malaria prevention. For maximum effectiveness, the nets should be re-impregnated with insecticide every six months.

15.7 TUBERCULOSIS

Tuberculosis (abbreviated as TB for *Tubercle bacillus*) is a common and deadly infectious disease caused by *Mycobacterium tuberculosis*. This disease commonly infects the lungs (as pulmonary TB) but can also affect the central nervous system, the lymphatic system, the circulatory system, the urinogenital system, bones, joints and even the skin. Other mycobacteria can also cause tuberculosis, but these species do not usually infect healthy adults.



Fig. 15.5: Chest X-ray showing TB infection

Over one-third of the world's population has been exposed to the TB bacterium, and new infections occur at a rate of one per second. Not everyone infected develops the full-blown disease, and so, latent TB infection with no visible symptoms is very common. However, 10% of latent infections will progress to active TB disease, which, if left untreated, kills more than 50% of its victims.

In 2004, 14.6 million chronic active TB cases, 8.9 million new cases, and 1.6 million deaths, were recorded, mostly in developing countries. In addition, a rising number of people in the developed world are contracting tuberculosis because their immune systems are compromised by immunosuppressive drugs, substance abuse or HIV/AIDS.

The rise in HIV infections and the neglect of TB control programs have resulted in resurgence of tuberculosis. The emergence of drug-resistant strains has also contributed to this new epidemic. The World Health Organization declared TB a global health emergency in 1993.

15.7.1 Symptoms

Symptoms of tuberculosis include chest pain, coughing up blood, and a productive, prolonged cough for more than three weeks. Other symptoms are fever, chills, night sweats, appetite loss, weight loss, pale complexion, and often a tendency to fatigue very easily.

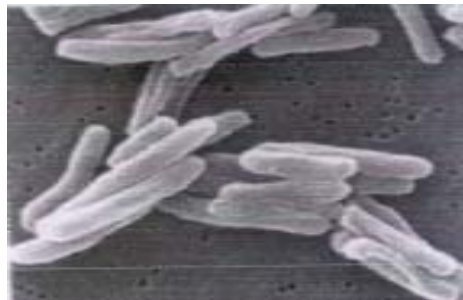


Fig.15.6 : *Mycobacterium tuberculosis* under Electron microscope

In some cases, the infection moves from the lungs to other body parts, causing other kinds of TB more common in immunosuppressed persons and young children. Newly infected sites include the pleura, the central nervous system in meningitis, the lymphatic system in scrofula of the neck, urogenital tuberculosis, bones and joints in Pott's disease of the spine.

15.7.2 Transmission

When people suffering from active pulmonary TB cough, sneeze, speak, kiss, or spit, they expel infectious minute aerosol droplets. A single sneeze, for instance, can release up to 40,000 droplets. People with prolonged, frequent, or intense contact are at high risk of becoming infected. A person with active but untreated tuberculosis can infect 10–15 other people per year. Others at risk include people in areas where TB is common, people who inject illicit drugs (especially when sharing needles), residents and employees of high-risk congested areas, medically under-served and low-income ethnic minority populations, children exposed to infected adults, HIV/AIDS patients with lowered immunity, people who take immunosuppressant drugs, and health care workers.

Transmission can only occur from people with active, not latent, TB. The probability of transmission from one person to another depends upon the number of infectious droplets expelled by a carrier, the effectiveness of ventilation, the duration of exposure, and the virulence of the *M. tuberculosis* strain. The chain of transmission can therefore be broken by isolating patients with active disease, and starting effective anti-tuberculous therapy. After two weeks of such treatment, people with non-resistant active TB generally cease to be contagious.

15.7.3 Prevention

TB prevention and control takes two parallel approaches. In the first, people with TB and their contacts are identified and then treated. Identification of infections often involves testing high-risk groups for TB. In the second approach, children are vaccinated to protect them from TB. Unfortunately, no vaccine is available that provides reliable protection for adults. However, in tropical areas where the incidence of atypical mycobacteria is high, exposure to nontuberculous mycobacteria gives some protection against TB.

Many countries use BCG (Bacillus Calmette-Guerin) vaccine as part of their TB control programs, especially for infants. This was the first vaccine for TB and developed at the Pasteur Institute in France between 1905 and 1921. However, mass vaccination with BCG did not start until after World War II. The protective efficacy of BCG for preventing serious forms of TB (e.g. meningitis) in children is greater than 80%; its protective efficacy for preventing pulmonary TB in adolescents and adults is variable, ranging from 0 to 80%.

Several new vaccines to prevent TB infection are being developed. The first recombinant tuberculosis vaccine entered clinical trials using mice in the United States in 2004. A very promising TB vaccine, MVA85A, is currently in phase II trials in South Africa by a group led by Oxford University, and is based on a genetically modified virus.



Fig. 15.7: Robert Koch

The bacillus causing tuberculosis, *Mycobacterium tuberculosis*, was identified and described on March 24, 1882 by **Robert Koch**. He received the Nobel Prize in physiology or medicine in 1905 for this discovery. Koch did not believe that bovine (cattle) and human tuberculosis were similar, which delayed the recognition of infected milk as a source of infection. Later, this source was eliminated by the pasteurization process. Koch announced a glycerine extract of the tubercle bacilli as a “remedy” for tuberculosis in 1890, calling it ‘tuberculin’. It was not effective, but was later adapted as a test for pre-symptomatic tuberculosis.

15.8 HEPATITIS

Hepatitis is a disease which is characterised by injury to the liver. A group of viruses known as the **hepatitis viruses** cause most liver damages worldwide. Hepatitis can also be due to toxins (notably alcohol), other infections or from autoimmune processes. It may occur in a person without any clinical symptoms and the affected person may not feel ill. Symptoms appear when the disease impairs functions of the liver such as removal of harmful substances from blood, regulation of blood composition and production of bile to help digestion.

Hepatitis may of two types, viz, 1. *Acute hepatitis* when it lasts less than 6 months, and 2. *chronic hepatitis* when it persists longer.

15.8.1 Causes

Acute hepatitis may occur due to the following causes:

- Viral Hepatitis: Hepatitis A to E (more than 95% of viral cause), Herpes simplex, adenoviruses.
- Non viral infection: toxoplasma, Leptospira, etc,
- Alcohol,
- Toxins: *Amanita* toxin in mushrooms, Carbon tetrachloride, asafoetida,
- Drugs: Paracetamol, amoxycillin, anti tuberculosis medicines, etc.
- Circulatory insufficiency,
- Pregnancy,
- Auto immune conditions.

Chronic hepatitis may occur due to the following causes:

- Viral Hepatitis: Hepatitis B with or without hepatitis D, Hepatitis C (Hepatitis A and E do not lead to chronic disease)
- Auto immune conditions
- Alcohol
- Drugs,
- Heredity.

15.8.2 Signs and symptoms

Acute Hepatitis may occur with mild symptoms requiring no treatment to serious hepatic failure needing liver transplantation. Acute viral hepatitis are more likely to be without any symptoms in younger people. In individuals showing symptoms the illness may last 2 to 6 weeks.

Initially, nonspecific flu-like symptoms, common to almost all acute viral infections may occur along with malaise, muscle and joint aches, fever, feeling sick or vomiting, diarrhoea and headache. More specific symptoms, which can be present in acute hepatitis from any cause are:

- i). profound loss of appetite,
- ii). aversion of smoking among smokers,
- iii). dark urine,
- iv). yellowing of the eyes and skin i.e. jaundice, and
- v). abdominal discomfort.

During the early stages of the **Chronic Hepatitis**, majority of patients will show no symptoms, or mild symptoms, abnormal blood tests being the only sign. Depending on the extent of liver damage or the cause of hepatitis, symptoms related to acute hepatitis will appear. Jaundice can be a late feature and may indicate extensive

damage. Other features include abdominal fullness from enlarged liver or spleen, low grade fever and fluid retention. Extensive damage and scarring of liver i.e. cirrhosis leads to weight loss, easy bruising and bleeding tendencies.

15.8.3 Types of hepatitis

Hepatitis A

Hepatitis A or infectious jaundice is caused by a picornavirus. It is transmitted by the consumption of contaminated food. It causes an acute form of hepatitis and does not have a chronic stage. The patient's immune system makes antibodies against Hepatitis A that confer immunity against future infection. People with Hepatitis A are advised to rest, drink adequate water and avoid alcohol. A vaccine is available that will prevent infection from hepatitis A for life. Hepatitis A can be spread through personal contact, consumption of raw contaminated food or drinking contaminated water. This occurs primarily in third world countries. Strict personal hygiene and the avoidance of raw and unpeeled foods can prevent infection. Infected people excrete the hepatitis A virus with their faeces two weeks before and one week after the appearance of jaundice. The time between the infection and the start of the illness can run from 15 to 45 days, and approximately 15% of sufferers may experience relapsing symptoms from six months to a year following initial diagnosis.

Hepatitis B

Hepatitis B is caused by a hepadnavirus, which can cause both acute and chronic hepatitis. Chronic hepatitis develops in the 15% of patients who are unable to eliminate the virus after an initial infection. Identified methods of transmission include blood transfusion, (now rare), tattoos (both amateur and professionally done), sexually (through sexual contact), or through contact with blood or bodily fluids, or via mother to child by breast feeding. Blood contact can occur by sharing syringes in intravenous drug use, shaving accessories such as razor blades, or touching wounds on infected persons.

Patients with chronic Hepatitis B have antibodies against Hepatitis B, but these antibodies are not enough to clear the infection that establishes itself in the DNA of the affected liver cells.

A vaccine is available that will prevent infection from Hepatitis B for life. Hepatitis B infections result in 5,00,000 to 12,00,000 deaths per year worldwide due to the complications of chronic hepatitis, cirrhosis, and liver cancer. Hepatitis B is endemic in a number of South-East Asian countries, making cirrhosis and liver cancer big killers.

Hepatitis C

Hepatitis C is caused by a Flavivirus. It can be transmitted through contact with blood (including through sexual contact) and can also cross the placenta. Hepatitis C may lead to a chronic form of hepatitis, culminating in cirrhosis. It can remain asymptomatic for 10-20 years. Patients with Hepatitis C are susceptible to severe

hepatitis if they contact either Hepatitis A or B. So, all Hepatitis C patients should be immunized against hepatitis A and hepatitis B if they are not already immune. The virus can cause cirrhosis of the liver.

Alcoholic hepatitis

Ethanol, mostly in alcoholic beverages, is a significant cause of hepatitis. Usually alcoholic hepatitis comes after a period of increased alcohol consumption. Alcoholic hepatitis is characterized by various symptoms, which may include feeling unwell, enlargement of liver, development of fluid in the abdomen, and modest elevation of liver blood tests. Alcoholic hepatitis can vary from mild with only liver test elevation to severe liver inflammation with development of jaundice, prolonged prothrombin time and liver failure. Severe cases are characterized by either obtundation (dulled consciousness) or the combination of elevated bilirubin levels and prolonged prothrombin time; the mortality rate in both categories is 50% within 30 days of onset.

Alcoholic hepatitis is distinct from cirrhosis caused by long term alcohol consumption. Alcoholic hepatitis can occur in patients with chronic alcoholic liver disease and alcoholic cirrhosis. Alcoholic hepatitis by itself does not lead to cirrhosis, but cirrhosis is more common in patients with long term alcohol consumption. Patients who drink alcohol to excess are also more often than others found to have hepatitis C. The combination of Hepatitis C and alcohol consumption accelerates the development of cirrhosis in Western countries.

Other toxins that cause hepatitis are Amatoxin in certain mushrooms, White phosphorus-an industrial toxin, Paracetamol when taken in an overdose, Carbon tetrachloride (a dry cleaning agent), Chloroform, etc.

Obstructive jaundice is the term used to describe jaundice due to obstruction of the bile duct (by gallstones or external obstruction by cancer). If longstanding it leads to destruction and inflammation of liver tissue.

Hepatitis awareness

World Hepatitis Awareness Day (1st October) is an annual event organised by several worldwide hepatitis advocacy groups to raise awareness of infectious hepatitis and demand action to curb the spread of the disease and treat people who are infected.

15.9 HIV and AIDS

AIDS (acquired immune deficiency syndrome) is a condition in humans in which the immune system begins to fail, leaving the body prone to life-threatening opportunistic infections. It is caused by a retrovirus named as human immunodeficiency virus or HIV (Family: Retroviridae; Genus: Lentivirus), which kills or impairs cells of the immune system and progressively destroys the body's ability to fight infections and certain cancers. The term AIDS applies to the most advanced stages of an HIV infection.

HIV primarily infects vital cells in the human immune system such as helper T cells (specifically CD4⁺ T cells), macrophages and dendritic cells. HIV infection leads



Fig. 15.8: Human Immunodeficiency Virus (HIV)

to low levels of CD4+ T cells. When CD4+ T cell numbers decline below a critical level, cell-mediated immunity is lost, and the body becomes progressively more susceptible to opportunistic infections. Healthy adults usually have CD4+ T-cell counts of 1,000 or more in the blood. All HIV-infected people with AIDS may have fewer than 200 CD4+ T cells. In addition, many other clinical conditions affect people with AIDS.

Two strains of HIV

HIV-1 is thought to have originated in southern Cameroon after jumping from wild chimpanzees (*Pan troglodytes troglodytes*) to humans during the twentieth century. HIV-1 is the virus that was initially discovered and termed LAV.

HIV-2 may have originated from the Sooty Mangabey (*Cercocebus atys*), an Old World monkey of Guinea-Bissau, Gabon, and Cameroon. HIV-1 is more virulent. It is easily transmitted and is the cause of the majority of HIV infections globally. HIV-2 is less transmittable and is largely confined to West Africa.

15.9.1 How is HIV/AIDS transmitted?

HIV is present in the blood, semen, vaginal fluid, pre-ejaculate, or breast milk of infected persons. Within these bodily fluids the virus occurs as both free virus particles and virus within infected immune cells. It is transmitted from one person to another by the following ways:

1. **Sexual Contact:** HIV is spread most commonly by sexual contact with an infected partner. The virus enters the body through the epithelial mucous lining of the sexual organs (vagina, vulva, and penis), rectum, or mouth during sexual activity.
2. **Blood Contamination:** HIV may also be spread through contact with infected blood. However, due to the screening of blood for evidence of HIV infection, the risk of acquiring HIV from blood transfusions is extremely low.
3. **Needles:** HIV is frequently spread by sharing needles, syringes, or drug use equipment with someone who is infected with the virus. Transmission from patient to healthcare worker, or vice-versa through accidental pricking with contaminated needles or other medical instruments, also occurs.
4. **Mother-to-child transmission.** The transmission of the virus from mother to child can occur in the uterus during the last weeks of pregnancy and at childbirth. In the absence of treatment, the transmission rate between the mother and child is 25%. However, where drug treatment and Caesarian section are available, this can be reduced to 1%. Breast feeding also presents a risk of infection for the baby.

HIV/AIDS cannot be spread through non bloody body fluids such as:

1. Saliva,
2. Sweat,

3. Tears,
4. Casual contact such as sharing food utensils, towels, and bedding,
5. Swimming pools,
6. Telephones,
7. Toilet seats, and
8. Biting by insects (such as mosquitoes).

15.9.2 What are the symptoms of HIV/AIDS?

Most people may develop a flu-like illness within 3-6 weeks after exposure to the HIV virus. Generally, many people do not develop any symptoms at all when they first become infected. In addition, the symptoms that do appear, which usually disappear within a week to a month, are often mistaken for those of another viral infection. The initial temporary symptoms may include:

1. sore throat,
2. fever,
3. headache,
4. malaise, and
5. enlarged lymph nodes.

Persistent or severe symptoms may not appear for 10 years or more, after HIV first enters the body in adults, or within two years in children born with an HIV infection. This "asymptomatic" period (during which no symptoms are observed) of the infection is highly variable from person to person. But, during the asymptomatic period, HIV is actively infecting and killing cells of the immune system. Its most obvious effect is a decline in the blood levels of CD4+ T cells (also called T4 cells), which are the key infection fighters of the body's immune system. The virus initially disables or destroys these cells without causing symptoms.

As the immune system deteriorates, complications begin to surface. The following are the most common complications, or symptoms, of AIDS. However, each individual may experience symptoms differently. Symptoms may include:

1. lymph nodes may remain enlarged for more than three months;
2. lack of energy;
3. weight loss;
4. frequent fevers and sweats;
5. persistent or frequent yeast infections (oral or vaginal);
6. persistent skin rashes or flaky skin;
7. pelvic inflammatory disease that does not respond to treatment;
8. short-term memory loss.

Some people develop frequent and severe herpes infections that cause mouth, genital, or anal sores, or a painful skin viral infection known as **shingles**. Children may have delayed development or failure to thrive.

During the course of the HIV infection, the number of CD4+ T cells gradually decline, although some individuals may have abrupt and dramatic drops in their counts.

The symptoms of an HIV infection may resemble other medical conditions. Hence, it is necessary to consult a physician for a diagnosis.

15.9.3 How is HIV/AIDS diagnosed?

Early HIV infection often causes no symptoms, and must be detected by testing a person's blood for the presence of antibodies (disease-fighting proteins) to HIV. These HIV antibodies generally do not reach levels high enough to detect by standard blood tests until one to three months following infection, and may take as long as six months. People exposed to HIV should be tested for HIV infection as soon as possible.

When a person is most likely to be infected with HIV and yet antibody tests are negative, a test for the presence of HIV itself in the blood is used. Repeat antibody testing at a later date, when antibodies to HIV are more likely to have developed, is always recommended. Rapid testing techniques are now available with results in less than 30 minutes.

15.9.4 Are we getting close to finding a vaccine for AIDS?

Even with extensive prevention efforts from multiple government and private agencies, HIV is still spreading worldwide. Many clinical trials are underway in an attempt to develop a vaccine against HIV, which could protect against infection and disease. According to the National Institute of Allergy and Infectious Disease (NIAID), an effective HIV vaccine, given before exposure to HIV, could have a number of possible outcomes including:

1. Preventing infection in most people,
2. Preventing infection in some people,
3. Preparing a person's immune system to block continued infection and eliminate the virus (vaccines against measles, mumps and polio work this way)
4. Delaying or preventing the onset of illness or AIDS

NIAID says that although the goal is to develop a vaccine that is 100 percent effective and protects everyone from infection, even a vaccine that only protects some people could still have a major impact on controlling the epidemic. They are quick to caution, however, that "even if an HIV vaccine is developed, education and other prevention efforts will be needed so that people continue to practice safe behaviours."

The National AIDS Control Organization (NACO), under the Ministry of Health & Family Welfare, is the nodal organization for formulation of policy and implementation of programs for prevention and control of HIV/AIDS in India.

NACO launched the third phase of National AIDS Control Programme in July 2007. The overall goal of NACP III is to halt and reverse the epidemic in India over the next five years by integrating programmes for prevention, care, support and treatment. The specific objectives of NACP III are to reduce the incidence of new infections by:

- Sixty percent in high prevalence states to reverse the epidemic; and
- Forty per cent in the vulnerable states so as to stabilize the epidemic.

Three key focus areas within NACP III which relate directly to children are

- prevention of HIV infection among high-risk populations and adolescents;
- prevention of parent-to-child transmission; and
- treatment of AIDS

The Red ribbon is an international symbol of AIDS awareness that is worn by people all year round and particularly around World AIDS Day to demonstrate care and concern about HIV and AIDS, and to remind others of the need for their support and commitment.



Fig. 15.9: The red Ribbon

The theme for World AIDS Day 2007 on December 1 is "Stop AIDS in Children"

15.10 RABIES

Rabies (Latin: rabies, "madness, rage, fury") is a viral zoonotic (transmitted from animals) disease that causes acute encephalitis or inflammation of the brain in mammals. In non-vaccinated humans, rabies is almost invariably fatal after characteristic neurological symptoms have developed, but with prompt vaccination after exposure to the virus, death of the patient may be prevented. There are only six known cases of a person surviving untreated rabies.

The rabies virus is a Lyssavirus. The virus has a bullet-like shape with a length of about 180 nm and a cross-sectional diameter of about 75 nm (1nm = 1/1000?). One end is rounded or conical and the other end is planar or concave. The lipoprotein envelope carries knob-like spikes composed of Glycoprotein G. Spikes do not cover the posterior end of the virus particle. Beneath the envelope is the membrane or matrix protein layer. The core of the virion consists of helically arranged ribonucleoprotein. The genome is unsegmented linear RNA.

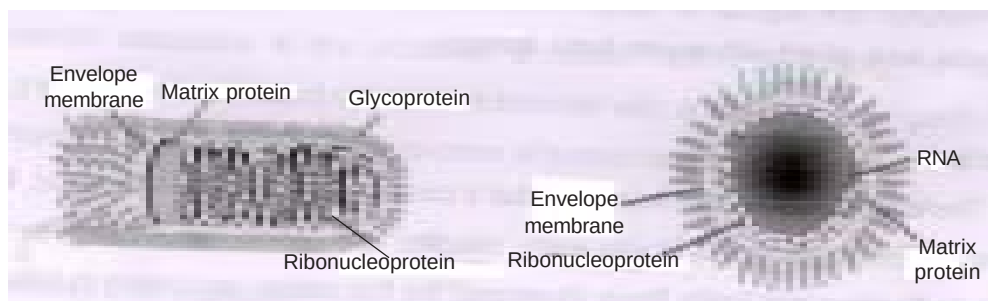


Fig.15.10: Longitudinal and cross-sectional schematic view of rabies virus

15.10.1 Transmission and symptoms

Any mammal, including humans may become infected with the rabies virus and develop symptoms. Most animals can be infected by the virus and can transmit the disease to humans. Infected dogs, cats, bats, monkeys, raccoons, foxes, skunks, cattle, wolves, provide the greatest risk to humans. Rabies may also spread through exposure to infected domestic farm animals, groundhogs, weasels and other wild carnivores. Squirrels, rodents and rabbits are seldom infected.

The virus is usually present in the nerves and saliva of a rabid (rabies infected) animal. The route of infection is usually by a bite. In many cases the affected animal is exceptionally aggressive, may attack without provocation, and exhibits otherwise uncharacteristic behaviour. Transmission may also occur via an aerosol through mucous membranes; transmission in this form may have happened in people exploring caves populated by rabid bats. Transmission between humans is extremely rare, although it can happen through transplant surgery, or, even more rarely, through bites or kisses.

After a typical human infection by bite, the virus directly or indirectly enters the peripheral nervous system. It then travels along the nerves towards the central nervous system. During this phase, the virus cannot be easily detected within the host, and vaccination may still confer cell-mediated immunity to prevent symptomatic rabies. Once the virus reaches the brain, it rapidly causes encephalitis and symptoms appear. It may also inflame the spinal cord producing myelitis.

The period between infection and the first flu-like symptoms is normally two to twelve weeks, but can be as long as two years. Soon after, the symptoms expand to slight or partial paralysis, cerebral dysfunction, anxiety, insomnia, confusion, agitation, abnormal behavior, paranoia, hallucinations, progressing to delirium. The production of large quantities of saliva and tears coupled with an inability to speak or swallow are typical during the later stages of the disease. This can result in "hydrophobia", where the victim has difficulty in swallowing, shows panic when presented with liquids to drink, and cannot quench his or her thirst. The disease itself was also once commonly known as hydrophobia, from these characteristic symptoms. Death almost invariably results two to ten days after the first symptoms. The few humans who are known to have survived the disease were all left with severe brain damage.

15.10.2 How rabies can be prevented ?

There is no known cure for rabies, but it can be prevented by vaccination, both in humans and other animals. Virtually every infection with rabies was a death sentence, until Louis Pasteur and Emile Roux developed the first rabies vaccination in 1885. This vaccine was first used on a human on July 6, 1885 on a nine-year old boy Joseph Meister (1876–1940) who had been mauled by a rabid dog.

The vaccine consisted of a sample of the virus harvested from nervous tissue of infected, dead rabbits. The virus was weakened by allowing it to dry. Similar nerve tissue-derived vaccines are still used now in some countries. Though much cheaper

than modern cell culture vaccines, they are not as effective and carry a certain risk of neurological complications.

The human diploid cell rabies vaccine (H.D.C.V.) was started in 1967. Human diploid cell rabies vaccines are made using the attenuated Pitman-Moore L503 strain of the virus. Human diploid cell rabies vaccines have been given to more than 1.5 million humans as of 2006. Newer and less expensive purified chicken embryo cell vaccine, and purified Vero cell rabies vaccine are now available.

New Zealand and Australia have never had rabies. However, in Australia, the Australian Bat Lyssavirus occurs normally in both insectivorous and fruit eating bats (flying foxes) from most mainland states. Scientists believe it is present in bat populations throughout the range of flying foxes in Australia.

Rabies and dogs

Three stages of rabies are recognized in dogs. The first stage is a one to three day period characterized by behavioral changes and is known as the prodromal stage. The second stage is the excitative stage, which lasts three to four days. It is this stage that is often known as furious rabies due to the tendency of the affected dog to be hyperreactive to external stimuli and bite at anything near. The third stage is the paralytic stage and is caused by damage to motor neurons. Incoordination is seen due to rear



Fig.15.11

limb paralysis and drooling and difficulty swallowing is caused by paralysis of facial and throat muscles. Death is usually caused by respiratory arrest.

15.11 NUTRITION

Nutrition is the way our body takes in and uses food. Foods that provide nutrition are called **nutrients**. Nutrients give us energy, brings growth, help repair body tissues, and regulate body functions. Therefore, each nutrient can be vital to our health.

There are six different types of nutrients. They are carbohydrates, proteins, fats, vitamins, minerals and water. Carbohydrates (essentially sugars and starches) supply us with energy while fibres keep the guts clean and healthy. Proteins build up and repair our body muscles, and make up hormones and enzymes. Fats are required for proper functioning of cells and the whole body. They also represent stored reserve food. The vitamins and minerals are so important that the proper functioning of the human body is affected if they are not present in the proper quantity. Water is required for proper functioning of all body parts. It is also required to flush out the waste products and remove the toxins from our body.

We need energy for all activities, including riding a bike, taking a test in school, or sleeping. The energy we use can also be called calories. A **calorie** is a measure of energy content in one or more foods. The more calories we eat, the more energy we will have. We get the calories from some of the nutrients.

A **balanced diet** is a combination of the various essential nutrients in the proper proportion. Carbohydrates are found in starches, sugars and fibres. Unrefined starchy foods like rice, bread, and potatoes in their skin are considered to be the best as they contain more vitamins, contain fibre and regulate the release of energy. Refined sugar and products containing it are termed as “empty calories” because they do not contain any nutrients. They only have energy giving properties. In contrast natural sugars present in fruits and vegetables are good for health. These carbohydrates should make up at least 40-50 percent of our diet.

Next on the list are proteins, the builders of muscle. Fish, milk, milk products, beans nuts, grains, soy and wheat germ all contain protein. These should be consumed in such a way that they account for about 20-30 percent of your diet.

Fats should not be excluded from the diet. What we need to do is to ensure that saturated fats be used sparingly. Polyunsaturated fats, which we get from different sources including fish oil, are considered to be more beneficial. Milk, butter, cheese, soy oil, olive oil, all contains fats. Fats should account for at least 30 percent of our diet.

Vitamins are vital for the human body for fighting infection and aiding bone growth, promoting cell production and boosting the immune system. Vitamin A and Riboflavin are found in milk, butter, fish and vegetables, thiamine in whole grain nuts and seeds, Niacin is found in milk, Vitamin B6 is found in spinach, broccoli and bananas, Vitamin C is found in green vegetables and citrus fruits, vitamin D is found in milk, Vitamin E is found in vegetables, rice, and bran, and Vitamin K is found in wheat germ, vegetable oil and whole grain bread and cereal.

Minerals like calcium which are necessary for bone growth and healthy teeth, copper which is require for the metabolism of iron. Magnesium which is involved with the functioning of the nerves and spinal cords, and sodium, potassium, phosphorous and zinc can be found either in milk, grains, vegetables, fruits, cereals, yogurt or wheat germ. Water is a vehicle for mixing of food with enzymes for transport of nutrients in various parts of the body and elemination of wastes etc. Drinking 8 glasses of water a day is good for health.

So, nutrition and a balanced diet contribute towards our good health. The body metabolism is increased with the right kind of breakfast foods. Regular moderate exercise will ensure that you look good, keep in good health and feel good.

15.11.1 Malnutrition

Malnutrition is a general term used for a condition caused by an improper or insufficient diet. It most often refers to **undernutrition** resulting from inadequate consumption, poor absorption, or excessive loss of nutrients. The term can also encompass **overnutrition**, resulting from overeating or excessive intake of specific nutrients. An individual will experience malnutrition if the appropriate amount of, or quality of nutrients comprising a healthy diet are not consumed for an extended period of time. An extended period of malnutrition can result in starvation, disease, and infections.

Malnutrition is the lack of sufficient nutrients to maintain healthy body functions and is typically associated with extreme poverty in economically developing countries. Malnutrition as the result of inappropriate dieting, overeating or the absence of a “balanced diet” is often observed in economically developed countries (eg. as indicated by increasing levels of **obesity**).



Fig. 15.12: An obese

Most commonly, malnourished people either do not have enough calories in their diet, or are eating a diet that lacks protein, vitamins, or trace minerals. Common forms of malnutrition include **protein-energy malnutrition (PEM)** and **micronutrient malnutrition**. PEM refers to inadequate availability or absorption of energy and proteins in the body. Malnutrition are commonly referred to as **deficiency diseases**.

As of 2006, malnutrition continues to be a worldwide problem. According to the Food and Agriculture Organization (FAO) of the United Nations, “850 million people worldwide were undernourished in 1999 to 2005, the most recent years for which figures are available” and the number of malnourished people has recently been increasing. An orange ribbon is used to raise awareness of malnutrition in the world.

15.12 PROTEIN-ENERGY MALNUTRITION (PEM)

15.12.1 Kwashiorkor

Kwashiorkor is a type of malnutrition with controversial causes, but it is commonly believed to be caused by insufficient protein intake. It usually affects children aged 1 – 4 years, although it also occurs in older children and adults. Jamaican pediatrician **Cicely D. Williams** introduced the name ‘**Kwashiorkor**’ in her article in the international scientific journal **Lancet** in 1935. When a child is breast-fed, it receives certain amino acids vital to growth from the mother’s milk. When the child is weaned, if the diet that replaces the milk is high in starches and carbohydrates, but deficient in protein, as is common in some parts of the world where the bulk of the diet consists of starchy food, or where famine has struck, the child may develop kwashiorkor.

Derivation of kwashiorkor

The name is derived from one of the languages of coastal Ghana and means “one who is physically displaced” reflecting the development of the condition in the older child who has been weaned from the breast milk.

Symptoms of kwashiorkor include

1. a swollen abdomen known, as a pot belly,
2. discoloration of the hair, and
3. depigmented skin.

The swollen abdomen is generally due to two causes: First cause is the accumulation of fluid in the peritoneal cavity. It is also thought to be attributed to the effect of malnutrition on lowering plasma proteins in blood, resulting in



Fig .15.13: Symptoms of kwashiorkor

increased osmotic movement of water through the capillary wall. A second cause may be due to a grossly enlarged liver due to fat deposition.

Victims of kwashiorkor fail to produce antibodies (disease-fighting substances of the body) following vaccination against diseases including **diphtheria** and **typhoid**. Generally, the disease can be treated by adding food energy and protein to the diet; however, mortality can be as high as 60% and it can have a long-term impact on a child's physical growth and, in severe cases, affect mental development.

Possible causes of kwashiorkor

It is now accepted that protein deficiency, in combination with energy and micronutrient deficiency, is an important cause of kwashiorkor.

Ignorance of nutrition can be a cause. Parents who feed their child mostly carbohydrate foods may fail to recognize malnutrition because of the oedema caused by the syndrome and the child may appear well-nourished despite the lack of dietary protein.

Other protein malnutrition syndromes include **marasmus** and **cachexia**, although the latter is often caused by underlying illnesses.

15.12.2 Marasmus

Marasmus is a form of severe protein-energy malnutrition characterised by energy deficiency. In dry climates marasmus is the more frequent disease associated with malnutrition.

A child with marasmus looks emaciated and the body weight may reduce to less than 80% of the normal weight for that height.

Marasmus occurs more frequently in infants below one year whereas kwashiorkor usually occurs after 18 months of age.



Fig.15.14: Marasmus signs

Signs

The common characteristic signs of protein-energy malnutrition are dry skin, loose skin folds on the buttocks and armpit, drastic loss of adipose tissue from normal areas of fat deposits like buttocks and thighs etc. The afflicted persons are often fretful, irritable, and voraciously hungry. There may be alternate bands of pigmented and depigmented hair, or flaky paint appearance of skin due to peeling.

15.13 SCURVY

Scurvy is a deficiency disease that results from insufficient intake of vitamin C, which is required for proper collagen synthesis in humans. The chemical name of vitamin C, ascorbic acid, is derived from the Latin name of scurvy, **scorbutus**. Scurvy is due to a prolonged deficiency of vitamin C in the diet and takes about 4 to 8 months to develop clinical signs. Scurvy leads to the formation of liver spots on the skin, spongy

gums, and bleeding from all mucous membranes. The spots are most abundant on the thighs and legs, and a person with the ailment looks pale, feels depressed, and is partially immobilized. In advanced stages of scurvy there are open, suppurating wounds and loss of teeth. Untreated scurvy is invariably fatal. However, since full recovery is achieved with the resumption of normal vitamin C intake, death from scurvy is rare in modern times.



Fig.15.15 :Scorbutic gums of a patient



Fig.15.16: Girl with a scorbutic tongue

In infants, scurvy is sometimes referred to as **Barlow's disease**, named after Sir Thomas Barlow (1845–1945), a British physician who described it.

Scurvy was at one time common among sailors, pirates and others who were on ships that were out to sea longer than perishable fruits and vegetables could be stored and by soldiers who were similarly separated from these foods for extended periods. It was described by **Hippocrates** (c. 460 BC–c. 380 BC). Its cause and cure have been known in many native cultures since prehistory. For example, in 1536, the French explorer **Jacques Cartier**, exploring the St. Lawrence River, used the local natives' knowledge to save his men who were dying of scurvy. He boiled the needles of the arbor vitae tree (Eastern White Cedar) to make a tea that was later shown to contain 50 mg of vitamin C per 100 grams. However it was a Scottish surgeon in the British Royal Navy, **James Lind** (1716–1794) who first proved it could be treated with citrus fruit in experiments he described in his 1753 book, *A Treatise of the Scurvy*.

15.13.1 Symptoms

Some important symptoms of scurvy are -

- i) gradual weakening and muscle pain,
- ii) dark purplish spots on tongue, skin on legs due to internal bleeding,
- iii) bleeding from all mucous membranes including conjunctiva,
- iv) Opening of scars and bone fractures that had healed many years before,
- v) spongy tender gums, often leading to tooth loss,
- vi) sunken eyes, and
- vii) pale skin,

15.13.2 Prevention

Scurvy can be prevented by a diet that includes certain citrus fruits such as oranges or lemons. Other good sources of vitamin C are fruits such as Indian gooseberry (Heikru), guava, papaya, passion fruit and strawberries. It can also be found in some vegetables, such as tomatoes, capsicum, broccoli (greenish cauliflower), potatoes, cabbage, spinach and papaya, as well as some pickled vegetables.

15.13.3 Food preparation

Vitamin C in most food sources decomposes during the cooking of food. Normal boiling water at 100°C is not hot enough to cause any significant destruction of the nutrient, which only decomposes at 190°C. However, vitamin C doesn't leach in all vegetables at the same rate; research shows broccoli seems to retain more than any other. Research has also shown that fresh-cut fruit don't lose significant nutrients when stored in the refrigerator for a few days.

Activity 15.1 collect some locally available vitamin C rich fruits and vegetables. You can use the list from the following table.

The following table shows the relative abundance of Vitamin C in different sources.

Table 15.1: Relative abundance of Vitamin C in some fruits and vegetables.

Food sources			Vitamin content
Common name	Scientific name	Local name	(mg / 100g)
Indian gooseberry	<i>Emblica officinalis</i>	Heikru	720
Red /Chinese Date	<i>Ziziphus jujuba</i>	Boroi achouba	500
Apple Guava	<i>Psidium guajava</i>	Pungdon	100
Lychee	<i>Litchi chinensis</i>	Litchi	70
Papaya	<i>Carica papaya</i>	Awathabi	60
Strawberry	<i>Fragaria orientalis</i>	Heijampet	60
Orange	<i>Citrus sinensis</i>	Komla	50
Lemon	<i>Citrus limon</i>	Champra	40
Cauliflower	<i>Brassica oleracea</i> var. <i>botrytis</i>	Kobi thamchet manbi	40
Passion fruit	<i>Passiflora edulis</i>	Sitaphon	30
Mustard	<i>Brassica campestris</i>	Hangam	30
Mango	<i>Mangifera indica</i>	Heinou	20

15.14 GOITRE

Goitre, (or **goiter**), also called a **bronchocele**, is a disease characterised by enlargement of the thyroid gland seen as a prominent swelling in the neck, just below

Adam's apple or larynx, due to an enlarged thyroid gland. It is most pronounced in simple goitre, which is caused by prolonged iodine deficiency in the diet. More common is toxic goitre or hyperthyroidism, caused by overactivity of the thyroid gland. Goitre was previously common in many areas that were deficient in iodine in the soil. The condition now is practically absent in affluent nations, where table salt is supplemented with **iodine**. However, it is still prevalent in India, Central Asia and Central Africa.

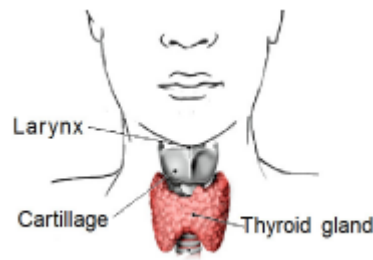


Fig. 15.17: Thyroid gland



Fig.15.18: A goitre patient

15.14.1 Causes

Important causes of goitre are:

- Prolonged Iodine deficiency in diet.
- Hashimoto's thyroiditis, an autoimmune disease characterized by inflammation of the gland.
- Graves-Basedow disease, a thyroid disorder characterized by hyperthyroidism.
- Inborn errors of thyroid hormone synthesis, causing congenital hypothyroidism
- Thyroid cancer

15.14.2 Symptoms

- Swelling of the thyroid gland, which may cause breathing and swallowing problems if the goitre is large enough and presses on the windpipe and oesophagus.
- Diminished power of concentration and problems with memory may also occur.
- Depression, emotional upsets and irritability is observed.
- Feeling tired and sleeping excessively.
- Increased appetite.
- Sweaty moist palms.
- Rapid heartbeat.
- Deteriorating or slowing growth rate.
- Dry, thickened skin and brittle hair.
- Slow reflexes.

Famous goitre sufferers

President **George H. W. Bush** and his wife **Barbara Bush** both were diagnosed with Graves disease and enlarged thyroid glands, within 2 years of each other. In the

president's case, the disease caused hyperthyroidism and cardiac dysrhythmia. North Korean Communist leader **Kim Il-sung** (1912 – 1994), was also a goitre patient.

15.15 Night blindness (Nyctalopia)

Nyctalopia (Greek for “*night blindness*”) is a condition making it difficult or impossible to see in relatively low light. It is a symptom of several eye diseases. Night blindness may exist from birth, or be caused by injury or vitamin A deficiency.

15.15.1 What are the causes of night blindness?

The most common cause of nyctalopia is deficiency of retinol, or vitamin A, found in fish oils, liver and dairy products. The retina is well supplied with an important chemical substance called rhodopsin, or “visual purple”. Light falling on the retina brings about certain chemical changes in the rhodopsin and other substances present in the rods and cones. These changes occur very rapidly, but large quantities of vitamin A are needed to bring this about. If there is any marked deficiency of vitamin A, night blindness may occur. This can usually be corrected by administering suitable amounts of vitamin A in the diet.

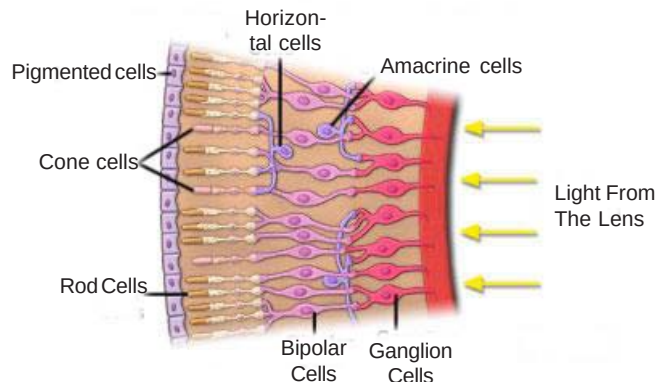


Fig. 15.19: Structure of the retina

The another common cause of nyctalopia is retinitis pigmentosa, a disorder in which the rod cells in the retina gradually lose their ability to respond to the light. Patients suffering from this genetic condition have progressive nyctalopia and eventually their daytime vision may also be affected. In X chromosome-linked congenital stationary night blindness, from birth the rods either do not work at all, or work very little, but the condition doesn't get worse.

The outer area of the retina is made up of more rods than cones. The rod cells are the cells that enable us to see in poor illumination. This is the reason why loss of side vision often results in night blindness. Individuals suffering from night blindness not only see poorly at night, but also require some time for their eyes to adjust from brightly lit areas to dim ones. Contrast vision may also be greatly reduced. Unless vitamin A intake is increased, the condition may get worse, especially when children also suffer from diarrhoea and other infections.

Historically, nyctalopia, also known as **moonblink**, was a temporary night blindness believed to be caused by sleeping in moonlight in the tropics.

Other causes of night blindness are-

- i). Cataracts, which are cloudy areas in the lens of the eye,
- ii). Certain medications, and
- iii). Birth defects

Night blindness may result due to certain disorders that affect the ability of the body to absorb vitamin A, e. g.

- i.). Liver disorders,
- ii). Surgery on the pancreas or liver, and
- iii). Intestinal conditions

15.15.2 What are the signs and symptoms of night blindness?

The main symptom of night blindness is difficulty or inability to see in low light or darkness. While driving, this may also occur a few seconds after the bright headlights of an oncoming vehicle have passed. Other associated symptoms include dry eyes, blurred vision, etc.

Eating a diet with adequate amounts of Vitamin A may help prevent night blindness. Foods sources of vitamin A are liver, fish-liver oil, butter, fortified margarine, etc. B-carotene or provitamin A is present in yellow, yellowish-red and green vegetables and fruits.

15.16 Rickets

Ricket is a softening of the bones in children potentially leading to fractures and deformity. Rickets is among the most frequent childhood diseases in many developing countries. The predominant cause is **vitamin D deficiency**, but lack of adequate **calcium** in the diet may also lead to rickets. Although it can occur in adults, the majority of cases occur in children suffering from severe malnutrition, usually resulting from famine or starvation during the early stages of childhood.



Fig.15.20:"rachitis" or "wrist widening" of rickets

Osteomalacia is the term used to describe a similar condition occurring in adults, generally due to deficiency of vitamin D. The word "rickets" comes from the word "rachitis," meaning wrist (and also spine), as wrist deformities are common in rickets.

Those at higher risk for developing rickets include:

- Breast-fed infants whose mothers are not exposed to sunlight
- Breast-fed infants who are not exposed to sunlight
- Individuals not consuming fortified milk,

Individuals with red hair have a decreased risk for rickets due to their greater production of vitamin D in sunlight.

Vitamin D is required for proper calcium absorption from the gut. In the absence of vitamin D, dietary calcium is not properly absorbed, resulting in hypocalcemia (low calcium level in blood), leading to skeletal and dental deformities, etc.

15.16.1 Signs and symptoms

Signs and symptoms of rickets include:

- i). Bone pain or tenderness,
- ii). dental problems,
- iii). muscle weakness,
- iv). bones with increased tendency for fractures,
- v). Skeletal deformity, e.g. bowed legs in toddlers;
- vi). cranial, spinal, and pelvic deformities;
- vii). Growth disturbance;
- viii). Hypocalcemia (low calcium level in the blood),
- ix). Tetany or uncontrolled muscle spasms, and
- x). Craniotabes (soft skull).



Fig.15.21: Rickets

15.16.2 Prevention

A sufficient amount of ultraviolet in sunlight each day and adequate supplies of calcium and phosphorus in the diet can prevent rickets. Darker-skinned babies need to be exposed longer to the ultraviolet rays. The replacement of vitamin D has been proven to correct rickets using these methods of ultraviolet light therapy and medicine.

Sufficient vitamin D levels can also be achieved through dietary supplementation. Vitamin D₃ (cholecalciferol) is the preferred form since it is more readily absorbed than vitamin D₂. Recommendations are for 200 international units (IU) of vitamin D a day for infants and children. Most dermatologists recommend vitamin D supplementation as an alternative to unprotected ultraviolet exposure due to the increased risk of skin cancer associated with sun exposure.

An infant child should be breast fed up to the 9th month. However, the breast-fed infants may not get enough vitamin D from breast milk alone. For this reason, it is recommended that infants who are exclusively breast-fed receive daily supplements of vitamin D from age of 2 months until they can start drinking vitamin D-fortified milk or formula a day. The foods of nursing mother also must have adequate vitamins. The food must contain a plenty of fresh milk from a cow fed on green grass, also butter, cream and yolk of egg but not any excess of carbohydrate. Plenty of sunlight, fresh air and muscular exercise are essential.

POINTS TO REMEMBER

- * Health is a state of complete physical, mental and social well-being.
- * The biological term for health is homeostasis, which is an organism's ability to efficiently respond to destabilising effects of various internal as well as external factors.
- * Mental health is a concept that refers to a human individual's emotional and psychological well-being.
- * Health of a person may become degraded due to lack of adequate nutritious food, lack of physical exercise, unfavorable environmental conditions, diseases, etc.
- * A disease is an abnormal condition of an organism that impairs bodily functions.
- * A symptom is a sensation or change in body functions experienced by a patient.
- * A sign is the evidence of the presence of a disease or disorder.
- * An infectious disease is a disease resulting from the presence of pathogenic microbial agents, including virus, bacteria, fungi, protozoa, etc.
- * Infectious diseases are usually known as contagious diseases (also called communicable diseases) due to their potentiality of transmission from one person or species to another.
- * Contagious diseases are transmitted by aerosols produced by coughs and sneezes, by bites of insects or other carries of the disease and from contaminated water or food (possibly by faeces or urine in the sewage), etc.
- * Diarrhoea is a common disease characterized by an increase in the frequency of bowel movements with a decrease in the form of stool (greater looseness of stool).
- * The looseness of stool in diarrhoea is caused by increased water in the stool.
- * Acute diarrhoea lasts a few days or up to a week, whereas chronic diarrhoea always lasts more than three weeks.
- * Viral gastroenteritis or viral infection of the stomach and the small intestine is caused by calcivituses.
- * Pathogenic strains of *E. coli* cause diarrhoea either by producing toxins or by invading and inflaming the lining of the small intestine and the colon, thus causing enterocolitis.
- * Dehydration occurs when there is excessive loss of fluids and minerals (electrolytes) from the body due to Diarrhoea, with or without vomiting.
- * Oral rehydration solutions (ORS) are liquids that contain a carbohydrare (glucose or rice syrup) and electrolytes.
- * Typhoid, or enteric fever is a disease caused by infection with *Salmonella typhi*.
- * Typhoid fever is characterized by continuous fever as high as (104°F), profuse sweating, rosy spots on the lower chest and abdomen, etc.

- * Typhoid infection may be prevented by using water that has been boiled or chemically disinfected.
- * The most serious forms of malaria are caused by *Plasmodium falciparum* and *Plasmodium vivax*.
- * Symptoms of malaria include fever, shivering, arthralgia (joint pain), vomiting, anaemia caused by haemolysis (destructing of blood cells), haemoglobinuria, and convulsions.
- * Tuberculosis is a common and infections disease caused by a bacteria known as *Mycobacterium tuberculosis*.
- * Symptoms of tuberculosis include chest paint, coughing up blood, and a productive, prolonged cough for more than three weeks.
- * Hepatitis A or infectious jaundice is caused by a picomavirus, which is transmitted through consumption of contaminated food and water.
- * Hepatitis B is caused by a hepadnavirus, which can cause both acute and chronic hepatitis.
- * Hepatitis C is caused by a Flavivirus transmitted through contact with blood (including through sexual contact).
- * AIDS (acquired immune deficiency syndrome) is a condition in humans in which the immune system begins to fail, leaving the body prone to life-threatening opportunistic infections.
- * Rabies is a viral *zoonotic* disease (transmitted from animals) that causes acute encephalitis or inflammation of the brain in mammals.
- * Hydrophobia is a characteristic symptom of rabies disease.
- * Nutrition is the way our body takes in and uses food.
- * Balanced diet is a combination of the various essential nutrients in the proper proportion.
- * Malnutrition is the term used for a condition caused by improper or insufficient diet.
- * Kwashiorkor and marasmus are the two main diseases of protein energy mal nutrition.
- * Scurvy is a deficiency disease resulting from insufficient intake of vitamin C.
- * Goitre is disease characterised by a enlargement of the thyroid gland in the neck due to insufficient intake of iodine.
- * Night blindness is a condition making difficult or impossible to see in relatively low light. It is caused by deficiency of vitamin A.
- * Ricket is a vitamin D deficiency disease found in children.

EXERCISES

1. *What is health?*
2. *What is a disease? What are its causes?*
3. *Define a symptom. Give two points of difference between symptom and sign of a disease.*
4. *Define diarrhoea. What are the signs of diarrhoea?*
5. *What is viral gastroenteritis? What are its symptoms?*
6. *Name the organisms which cause the following diseases: (a) Traveler's diarrhoea; (b) Food poisoning. (c) Enterocolitis.*
7. *What is dehydration? When does it occurs?*
8. *What are the conditions when a doctor should be consulted to treat a diarrhoea patient?*
9. *Which organism causes typhoid or enteric fever? What are its symptoms?*
10. *What are the preventive measures for typhoid or Enteric fever?*
11. *What is malaria? What are its symptoms? Give the name of organisms causing malaria? Which organism spreads the disease?*
12. *Which malarial parasites cause severe and chronic malaria?*
13. *What is tuberculosis? Which organism causes the disease? What are symptoms of tuberculosis?*
14. *How is tuberculosis transmitted from one person to another? How can we protect ourselves against infection with tuberculosis?*
15. *What is Hepatitis? What are the common causes of Hepatitis? What are the symptoms of acute hepatitis?*
16. *Write briefly on (i) Hepatitis A, (ii) Hepatitis B, and (iii) Hepatitis C*
17. *Write what you know about Alcoholic Hepatitis.*
18. *Write what you know about HIV/AIDS?*
19. *What are the ways through which a person can become infected with HIV?*
20. *What are the initial temporary symptoms of HIV infection?*
21. *What are the common symptoms that may appear in an HIV/AIDS infected person with weakened immune system?*
22. *What s Rabies? Name the organism that causes Rabies. How can we protect ourselves against Rabies infection?*
23. *Define nutrition.*
24. *What are nutrients? What are the different types of nutrients?*
25. *What is meant by a balanced diet? Write down the approximate proportions of various nutrients in a balanced died?*
26. *What is malnutrition? Distinguish between undernutrition and overnutrition.*
27. *Define Protein Energy Malnutrition and Micronutrient malnutrition.*
28. *Differentiate between Kwashiorkor and Marasmus.*
29. *What is Scurvy? What are its symptoms.*
30. *What is goitre? Write down its causes and symptoms.*
31. *Write the causes of night blindness. How can we prevent night blindness ?*
32. *Define Rickets. What are its causes and symptoms? Mention one preventive measure for Rickets.*