

UNIT – 1

What is health? How will health be affected?

Health is the state of complete physical, mental, and social wellbeing.

Health increases productivity and ensures longevity.

It is affected by –

- 1) Genetic disorders – deficiencies with which a child is born and deficiencies/defects which the child inherits from parents from birth;
- 2) Infections and
- 3) Lifestyle including food and water we take, rest and exercise we give to our bodies, habits that we have or lack etc.

How to ensure good health?

Balanced diet, personal hygiene and regular exercise are very important to maintain good health.

Yoga has been practiced since time immemorial to achieve physical and mental health. Awareness about diseases and their effect on different bodily functions, vaccination (immunization) against infectious diseases, proper disposal of wastes, and control of vectors and maintenance of hygiene in food and water resources are necessary for achieving good health.

What are the various public health measures, which you would suggest as safeguard against infectious diseases?

Public health measures are preventive measures which are taken to check the spread of various infectious diseases.

These measures should be taken to reduce the contact with infectious agents.

Some of these methods are:

- 1) **Maintenance of personal and public hygiene:** It is one of the most important methods of preventing infectious diseases. This measure includes maintaining a clean body, consumption of healthy and nutritious food, drinking clean water, etc. Public hygiene includes proper disposal of waste material, excreta, periodic cleaning, and disinfection of water reservoirs.
- 2) **Isolation:** To prevent the spread of air-borne diseases such as pneumonia, chicken pox, tuberculosis, etc., it is essential to keep the infected person in isolation to reduce the chances of spreading these diseases.
- 3) **Vaccination:** Vaccination is the protection of the body from communicable diseases by administering some agent that mimics the microbe inside the body. It helps in providing

passive immunization to the body. Several vaccines are available against many diseases such as tetanus, polio, measles, mumps, etc.

- 4) **Vector Eradication:** Various diseases such as malaria, filariasis, dengue, and chikungunya spread through vectors. Thus, these diseases can be prevented by providing a clean environment and by preventing the breeding of mosquitoes. This can be achieved by not allowing water to stagnate around residential areas. Also, measures like regular cleaning of coolers, use of mosquito nets and insecticides such as malathion in drains, ponds, etc. can be undertaken to ensure a healthy environment. Introducing fish such as Gambia in ponds also controls the breeding of mosquito larvae in stagnant water.

What are the types of diseases? What's the difference between infectious diseases and non-infectious diseases?

Diseases can be broadly grouped into infectious and non-infectious.

Diseases which are easily transmitted from one person to another, are called infectious diseases. Infectious diseases are very common and every one of us suffers from these at some time or other. Some infectious diseases like AIDS are fatal. Among non-infectious diseases, cancer is the major cause of death. Drug and alcohol abuse also affect our health adversely.

Infectious diseases are illnesses caused by harmful organisms (pathogens) that get into your body from the outside. Pathogens that cause infectious diseases are viruses, bacteria, fungi, parasites and, rarely, prions. You can get infectious diseases from other people, bug bites and contaminated food, water or soil.

Infectious diseases are caused by harmful organisms that get into your body from the outside, like viruses and bacteria. Non-infectious diseases aren't caused by outside organisms, but by genetics, anatomical differences, getting older and the environment you live in. You can't get non-infectious diseases from other people, by getting a bug bite or from your food.

The flu, measles, HIV, strep throat, COVID-19 and salmonella are all examples of infectious diseases. Cancer, diabetes, congestive heart failure and Alzheimer's disease are all examples of non-infectious diseases.

In which way has the study of biology helped us to control infectious diseases?

Various advancements that have occurred in the field of biology have helped us gain a better understanding to fight against various infectious diseases. Biology has helped us study the life cycle of various parasites, pathogens, and vectors along with the modes of transmission of various diseases and the measures for controlling them. Vaccination programmes against several infectious diseases such as smallpox, chicken pox, tuberculosis, etc. have helped eradicate these diseases. Biotechnology has helped in the preparation of newer and safer drugs and vaccines. Antibiotics have also played an important role in treating infectious diseases.

What are pathogens? List the types of pathogenic diseases.

Pathogens are the parasites that enter the human body through various means, then multiply, and interfere with normal vital activities.

Types are:

- 1) Bacterial Diseases.
- 2) Viral Diseases.
- 3) Fungal Diseases
- 4) Protozoan Diseases.
- 5) Diseases Caused by Worms.

What are the bacterial diseases? Explain them briefly Typhoid.

- Pathogen– *Salmonella typhi*.
- Spreads through – Contaminated food and water.
- Site of infection – small intestine.
- Symptoms – High fever, stomach pain, headache, loss of Appetite, constipation, and intestinal perforations in severe cases.
- Pathogens – *Streptococcus pneumoniae* and *Haemophilus Influenza*.
- Confirmatory test – Widal test pneumonia.
- Spreads through – Droplets/aerosols released from infected person, sharing of glasses or utensils.
- Site of infection – Alveoli (gets filled with fluid, difficulty in breathing).
- Symptoms – Fever, chills, cough, headache, lips and nails become grey in severe cases.

What are the viral diseases? Explain them briefly Common cold

- Pathogen – Rhino viruses
- Site of infection – Nose and respiratory passage
- Spreads through – Droplets released from coughing or sneezing, or contaminated objects
- Symptoms – Nasal congestion and discharge, sore throat, cough, headache, tiredness

What are Protozoan diseases? Explain them briefly

1) Malaria

- Pathogen – *Plasmodium* sps. (*P. vivax*, *P. falciparum*, *P. malaria*)
- Vector – Female *Anopheles* mosquito
- Symptoms – High grade fever, chills

2) Amoebiasis

- Pathogen – *Entamoeba histolytica*
- Vector – Housefly
- Site of infection – large intestine
- Symptoms – Constipation, abdominal pain, cramps, stools with mucus, and blood clots.

What are the fungal diseases? Explain them briefly

Ringworms

- Pathogens – Genera Microsporum, Trichophyton, and Epidermophyton
- Spreads through – Towels, clothes, comb (Fungus is acquired from soil)
- Symptoms – Appearance of dry, scaly lesions on various body parts with intense itching

What are the diseases caused by worms? Explain them briefly Diseases Caused by Worms.

1) Ascariasis:

- Pathogen – Round worm, Ascaris
- Spreads through – Water, vegetables, fruits contaminated by feces of infected person
- Symptoms – Internal bleeding, muscular pain, fever, anemia, blockage of intestinal passage.

2) Elephantiasis (filariasis):

- Pathogen – Wuchereria (W.malayi and W.bancrofti)
- Spreads through – Bite of female mosquito vector
- Symptom – Chronic inflammation of the organs, usually the lymphatic vessels of lower limb.

Explain life cycle of plasmodium

- Life Cycle of Plasmodium
- Plasmodium requires two hosts to complete its life cycle.
- when a female Anopheles mosquito bites a healthy human being, it releases Plasmodium, which lives in its body as a sporozoite (infectious form).
- The parasites multiply (asexual reproduction) in the liver cells and finally burst the liver cells. Sporozoites are released in blood.
- Parasites enter RBCs and further multiply (asexual reproduction) here and finally burst RBCs also.
- Bursting of RBCs is accompanied by release of a toxic substance called hemozoin (associated with fever and chills).
- In the RBCs, only sporozoites change into gametocytes (sexual stage).
- Gametocytes multiply.
- When the diseased person is bitten by a female Anopheles mosquito, gametocytes are introduced into the mosquito.
- Gametocytes fertilize and develop inside the intestine of mosquitoes to form sporozoites.
- Sporozoites are stored in the salivary glands of mosquitoes and are released into the healthy person who is bitten by this mosquito.

UNIT – 2

What is immunity? Explain the types of immunity.

The ability of body to fight the disease-causing organisms is called immunity. Everyday our body comes in contact with several pathogens, but only a few results into diseases. The reason is, our body has the ability to release antibodies against these pathogens and protects the body against diseases. This defence mechanism is called immunity.

Types of immunity: -

- Immunity is of two types – innate immunity and acquired immunity.
- Innate immunity – It is present from the time of birth. It is nonspecific. This is activated immediately when the pathogen attacks.

Innate immunity: -

includes certain barriers and defence mechanisms that keep foreign particles out of the body. It is a long-term immunity in which our body produces the antibodies on its own. Our body has few natural barriers to prevent the entry of pathogens.

It consists of 4 kinds of barriers:-

- 1) Physical barriers – Skin and mucus coating of respiratory, gastrointestinal, and urogenital tract prevent entry of microbes into body.
- 2) Physiological barriers – Acid in stomach, saliva in mouth, tears from eyes.
- 3) Cellular barriers – Blood has leukocytes such as polymorpho nuclear leukocytes, monocytes, etc... and tissue has macrophages which phagocytose the microbes.
- 4) Cytokine barriers – Special proteins called interferons are secreted by virus infected cells that prevent the further spread of viral infection.

Acquired immunity

It is acquired, which means that it is produced in response to an encounter with a pathogen based on memory. It is pathogen specific.

- When a pathogen for the first time infects a person, low intensity immune response is generated (primary response).
- When the same pathogen attacks again, intensified immune response is generated, thereby preventing the occurrence of disease (secondary response).
- Acquired immunity involves two types of cells – B lymphocytes and T lymphocytes.
- B lymphocytes – Secrete proteins called antibodies in response to pathogens. Antibodies are specialized proteins with 4 peptide chains (2 light and 2 heavy), hence denoted as H2L2. IgA IgM, IgE, etc. are examples of some of the antibodies. They generate humoral immune response (found in blood).

- **T lymphocytes** – they help B cells to produce antibodies. They generate cell mediated immune response. This response helps the body to differentiate between 'self' and 'non self' as occurs in case of graft rejection.

Difference between active immunity and passive immunity.

Active Immunity

Active immunity involves the direct response to a foreign antigen within the body. In the case of the acquired or adaptive immune system, the body remembers the pathogens it has encountered in the past. This is a direct result of the active immune system. Active immunity occurs when we are in contact with the pathogen or its antigen.

Antigens stand for antibody generator. It is with the help of antigens released by the pathogen that our body tackles the pathogen.

So what our body does is, it starts producing antibodies to attack the pathogen based on its antigen. When this happens for the first time, it is called a primary response. Once a body experiences a pathogen for the first time, it keeps a few of the antibodies that attacked the pathogen just in case it attacks for the second time. This is known as natural active immunity.

Passive immunity

Passive immunity involves the immune response by the antibodies attained from outside the body. The primary response by the body to a pathogen it encounters for the first time is rather feeble, so the first encounter is always a little harsh on the body.

What if we could immunize everyone without the need for them ever getting sick?

Biotechnology has grown tremendously in the last decade or two and now we are capable of manufacturing antibodies for diseases. These ready-made antibodies protect the body even if the body hasn't yet experienced a primary response.

While active immunity may protect us from a disease for a lifetime, passive immunity is the more short term.

Passive immunity develops immediately and our body could begin its attack on the pathogen right away.

There are two types of passive immunity:

- 1) Natural Passive Immunity
- 2) Artificial Passive Immunity
- 3) **How does vaccination help?**

- Vaccines are nothing but inactivated pathogens.
- These inactivated pathogens when introduced in the body produce a primary immune response and antibodies are produced against the pathogen.
- Memory B and T cells are produced.

- Now when the pathogen again attacks the person, memory B and T cells generate a massive immune response and the pathogen is killed.
- A vaccine is made up of the antigens of the pathogen that cause the disease. For e.g., the smallpox vaccine contains the antigens of the pathogen causing smallpox disease. When a person is vaccinated with the smallpox vaccine the antibody producing cells are stimulated that produce smallpox antibodies. Thus, the body is protected against the disease occurring in future.
- Vaccinating pathogenic **microbes** into our body deliberately produces a similar response and is termed as artificially acquired immunity.
- Immunization is a process providing resistant to pathogenic microbes and other infectious diseases by the administration of a vaccine into the body. By immunization, it stimulates the body's immune system to protect against subsequent infection or disease.

What are the problems of immune system?

Problems of immune system

1) Allergies

- Exaggerated immune response to certain antigens present in environment
- Allergens – Substances in response to which allergy is produced
E.g., dust, pollen, etc.
- Antibodies involved – IgE type
- During allergic reactions, chemicals such as histamines and serotonin are released.
- Symptoms – Sneezing, watery eyes, difficulty in breathing, etc.
- Allergy test – Patient is injected with small doses of allergens to monitor his response.
- Antihistamines, adrenalins, and steroids may be given so that the symptoms of allergy.

2) Autoimmunity

- In autoimmunity, body generates immune response against its own cells.
- Reasons – Genetic and other unknown reasons
- Example – Rheumatoid arthritis is an autoimmune disease.

Explain Human immune system.

The purpose of the immune system is to defend itself and keep microorganisms, such as certain bacteria, viruses, and fungi, out of the body, and to destroy any infectious microorganisms that do invade the body. The immune system is made up of a complex and vital network of cells and organs that protect the body from infection.

The organs involved with the immune system are called the lymphoid organs. They affect growth, development, and the release of lymphocytes (a type of white blood cell). The blood vessels and

lymphatic vessels are important parts of the lymphoid organs. They carry the lymphocytes to and from different areas in the body. Each lymphoid organ plays a role in the production and activation of lymphocytes.

Lymphoid organs are of **two** types – **primary lymphoid organs** and **secondary lymphoid organs**: -

- 1) Primary lymphoid organs consist of bone marrow and thymus. Here, immature lymphocytes are differentiated to form antigen sensitive lymphocytes.
 - Thymus – It is responsible for maturation of T lymphocytes. This lobed organ is situated near the heart and keeps on reducing in size as the age increases.
- 2) Bone marrow – Here, all blood cells including lymphocytes are produced.
- 3) Secondary lymphoid organs – Lymphocytes migrate here after attaining maturity. It includes spleen, lymph nodes tonsils, Peyer's patches, and appendix.
 - Spleen – Large bean shaped organ containing lymphocytes and phagocytes, which acts as a filter for blood
 - Lymph nodes – Located at different points throughout the immune system, they trap the antigens present in lymph or tissue fluid, and these antigens cause activation of lymphocytes and generation of immune response.
- 4) MALT (Mucosal associated lymphoid tissue) – Lines major tracts (respiratory, digestive, urogenital, etc) ; Constitutes 50% of lymphoid tissue in body.

Explain innate immunity.

This type of immunity is present in an organism by birth. This is activated immediately when the pathogen attacks.

Innate immunity includes certain barriers and defence mechanisms that keep foreign particles out of the body.

It is a long-term immunity in which our body produces the antibodies on its own. Our body has few natural barriers to prevent the entry of pathogens.

It consists of 4 kinds of barriers.

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Explain about Allergies.

- The exaggerated response of the immune system to certain antigens present in the environment is called allergy.
- The substances to which such an immune response is produced are called allergens.
- The antibodies produced to these are of IgE type. Common examples of allergens are mites in dust, pollens, animal dander, etc.
- Symptoms of allergic reactions include sneezing, watery eyes, running nose and difficulty in breathing.
- Allergy is due to the release of chemicals like histamine and serotonin from the mast cells.
- For determining the cause of allergy, the patient is exposed to or injected with very small doses of possible allergens, and the reactions studied.
- The use of drugs like anti-histamine, adrenalin and steroids quickly reduce the symptoms of allergy.

- Somehow, modern-day life style has resulted in lowering of immunity and more sensitivity to allergens – more and more children in metro cities of India suffer from allergies and asthma due to sensitivity to the environment.
- This could be because of the protected environment provided early in life.

Explain about Cells involved in innate immunity.

- 1) **Phagocytes:** These circulate through the body and look for any foreign substance. They engulf and destroy it defending the body against that pathogen.
- 2) **Macrophages:** These have the ability to move across the walls of the circulatory system. They release certain signals as cytokines to recruit other cells at the site of infections.
- 3) **Mast Cells:** These are important for healing wounds and defence against infections.
- 4) **Neutrophils:** These contain granules that are toxic in nature and kill any pathogen that comes in contact.
- 5) **Eosinophils:** These contain highly toxic proteins that kill any bacteria or parasite in contact.
- 6) **Basophils:** These attack multicellular parasites. Like the mast cells, these release histamine.
- 7) **Natural Killer Cells:** These stop the spread of infections by destroying the infected host cells.
- 8) **Dendritic Cells:** These are located in the tissues that are the points for initial infections. These cells sense the infection and send the message to the rest of the immune system by antigen presentation.

Explain 4 kinds of barriers of innate immunity.

- 1) **Physical barriers:** Skin on our body is the main barrier which prevents entry of the micro-organisms. Mucus coating of the epithelium lining the respiratory, gastrointestinal and urogenital tracts also help in trapping microbes entering our body.
- 2) **Physiological barriers:** Acid in the stomach, saliva in the mouth, tears from eyes—all prevent microbial growth.
- 3) **Cellular barriers:** Certain types of leukocytes (WBC) of our body like polymorph-nuclear leukocytes (PMNL-neutrophils) and monocytes and natural killer (type of lymphocytes) in the blood as well as macrophages in tissues can phagocytise and destroy microbes. (iv) **Cytokine barriers:** Virus-infected cells secrete proteins called interferons which protect non-infected cells from further viral infection.

Features of Acquired Immunity

- **Specificity:** Our body has the ability to differentiate between different types of pathogens, whether it is harmful or not, and devise ways to destroy them.
- **Diversity:** Our body can detect vast varieties of pathogens, ranging from protozoa to viruses.
- **Differentiate between self and non-self:** Our body has the unique ability to differentiate between its own cells and foreign cells. It immediately starts rejecting any foreign cell in the body.

- **Memory:** Once our body encounters a pathogen, it activates the immune system to destroy it. It also remembers what antibodies were released in response to that pathogen, so that, the next time it enters, a similar procedure is followed by the body to eliminate it.

Explain about Lymphoid Organs

- The organs of the immune system which are involved in defending the body against invading pathogens causing infections or spread of tumours is termed as Lymphoid organs. It includes bone marrow, blood vessels, lymph nodes, lymphatic vessels, thymus, spleen, and various other clusters of lymphoid tissue.
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1) Primary lymphoid organs:

The primary lymphoid organs produce and allow the maturation of lymphocytes. It also serves by generating lymphocytes from immature progenitor cells. Therefore, it is referred to as the central lymphoid organs. Examples of primary lymphoid organs include thymus and the bone marrow.

2) Secondary lymphoid organs:

The secondary lymphoid organs *are* referred to as the peripheral lymphoid organs as they are involved in promoting the sites for the interaction of lymphocytes with the antigen to become effector cells.

3) Tertiary lymphoid organs:

The tertiary lymphoid organs usually contain very less number of lymphocytes. It plays an important role during the inflammation process.