

NEET Revision Notes

Biology

Human Health and Disease

Introduction

Health is defined as a state of mental, social and physical being. Disease on the other hand is disturbance in the proper functioning of the body. Which further affects the functioning of organs and organ systems. Thus, both health and disease together contribute to the state of entire well-being. Human health and diseases is an important topic that needs to be studied for a better understanding of our body.

Types of Diseases

The human body suffers from many diseases. Diseases occur due to genetic defects, infections or an unhealthy lifestyle.

Diseases can be classified into two types:

1. **Congenital Diseases:** The diseases that are present by birth. These are genetic in nature. These may be due to gene mutation, chromosomal aberration or environmental effects. These defects are transferred from one generation to the other. e.g. Hemophilia, color blindness, Down syndrome, Turner's syndrome, etc.
2. **Acquired Diseases:** The diseases that are acquired during a lifetime are known as acquired diseases.
 - a. **Infectious or communicable disease:** These are transmitted from one person to another.
 - b. **Non-communicable disease:** These kinds of diseases do not spread by infection.
 - c. **Deficiency disease:** Such kinds of diseases are caused due to deficiency of an important nutrient, enzyme or hormones, e.g. anemia, kwashiorkor, beriberi, diabetes, etc.
 - d. **Allergies:** hypersensitivity to foreign substances causes some kinds of allergies. The allergies are caused by pollen, dust, mites, etc.

Common Diseases in Humans

- The disease-causing organism is known as a pathogen, e.g. bacteria, virus, protozoan, fungi, worms.

There are many ways by which a pathogen can enter our body. Here is a table of the most common diseases found in humans.

Name of the disease	Causing agent/ pathogen	Vector/ mode of infection	Symptoms	Effects
Typhoid	<i>Salmonella typhi</i> (Bacteria)	By contaminated food and water	Continued high fever, headache, stomachache, constipation and loss of appetite	Can be diagnosed by Widal test. Intestinal perforation in severe cases
Pneumonia	<i>Streptococcus pneumoniae</i> , <i>Haemophilus influenzae</i> (Bacteria)	By inhaling droplets or aerosols released by an infected person or using infected utensils	Fever, chills, cough and headache	Respiration problems due to fluid that gets filled in the alveoli
Common cold	Rhinoviruses	By cough, sneezes and contaminated objects	Nasal congestion and discharge, sore throat, cough, headache	Nose and respiratory passage

Malaria	<i>Plasmodium falciparum, P. vivax</i> (Protozoan)	Female anopheles mosquito is a vector. Spread by mosquito bite	High fever with chills	The parasite multiplies in liver cells, attacks RBCs and rupture
Amoebic dysentery	<i>Entamoeba histolytica</i> (Protozoan)	Houseflies are a carrier -spread by contaminated food by the faecal matter	Constipation, abdominal pain, mucous and blood in the stool	Infection in the large intestine
Ascariasis	<i>Ascaris</i> (Helimenthos)	Contaminated water, vegetables, fruits. Parasite eggs are excreted out in faeces of the infected person, which contaminates soil	Muscular pain, internal bleeding, anaemia, fever	Blockage of intestinal passage

Filariasis/ Elephantiasis	<i>Wuchereria bancrofti</i> , <i>W.malayi</i> (Helminthes)	Bloodsucking black flies and female mosquitos act as a vector	Inflammation of the lower limb and genital organs	Lymphatic vessels, especially of the lower limbs, get blocked
Ringworms	<i>Microsporum</i> , <i>Trichophyton</i> , <i>Epidermophyton</i> (Fungi)	Spread from the soil, using a towel, clothes or comb of an infected person	Dry scaly lesions, itchy skin	Effects skin, nail scalp

The lifecycle of *Plasmodium* (malarial parasite)

- *Plasmodium* enters the body by the bite of female *Anopheles* mosquitoes.
- The infectious form is sporozoites, which come from the saliva of female anopheles when they bite.
- It further multiplies in the liver cells and then attacks RBCs resulting in RBCs rupture.
- A toxic substance known as Hemozoin is released.
- The gametocyte from the human blood gets transferred to the mosquito when it bites an infected person.
- Further sporozoites are formed.
- These sporozoites migrate to the salivary gland of mosquitoes and the cycle is repeated.
- *Plasmodium sp.* needs human and female *Anopheles* mosquitoes to complete their life cycle.

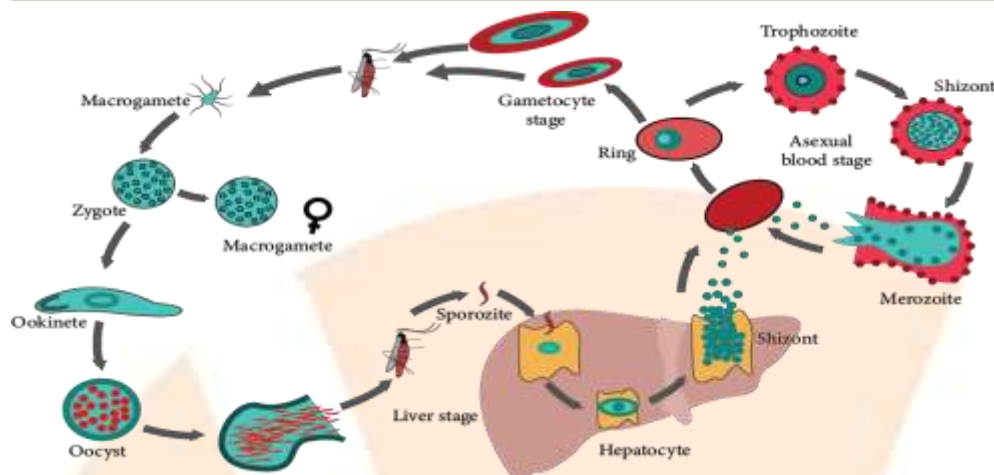


Image: Life cycle of *Plasmodium falciparum*

Types of Immunity

- Immunity is defined as the ability of the body to protect and fight against any pathogen or foreign body.
- The immune system defends our body against any infection.

There are two types of immunity:

Innate immunity: This immunity is present at the time of birth. There are 4 types of barriers present in the defence mechanism of our body.

- **Physical barriers:** skin and mucous coating of the epithelial lining of the respiratory, gastrointestinal, and urinary tract.
- **Physiological barriers:** saliva, tears, and stomach acid.
- **Cellular barriers:** neutrophils, monocytes, natural killer lymphocytes.
- **Cytokine barriers:** interferons that are secreted by virus-infected cells.

Acquired immunity is something that we acquire during the lifespan moreover it is pathogen-specific in nature.

- The primary response towards acquired immunity is seen after the first encounter with a pathogen.
- Often infection results in secondary response or anamnestic response due to memory of the first response.
- B-lymphocytes produce antibodies in response to a foreign antigen.

- Antibodies are Y shaped protein molecules. Antibodies have 4 peptide chains out of these 2 are light and 2 are heavy in nature.

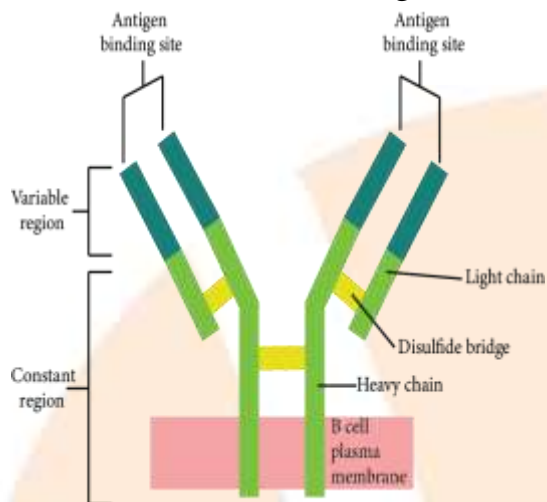


Image: Structure of an Antibody

- There are five types of antibodies present in humans; IgG, IgM, IgD, IgA and IgE.
- IgG is the most abundant antibody that is found in the blood.
- IgG is transferred to a foetus through the placenta and protects the infant until their own immunity develops.
- IgA is present in the breast milk colostrum, the yellowish fluid secreted initially during lactation has a lot of IgA.
- IgE is involved in the allergic reaction.
- T-lymphocytes mediate the cell-mediated response.
- Cell-mediated response is responsible for distinguishing between self and non-self.

Active immunity: Antibodies are produced in the host body in response to antigen. Vaccination, where a pathogen is injected is a type of active immunity.

Passive immunity: Giving ready-made antibodies to get the quick response against a pathogen is known as passive immunity. Injecting antitoxin for snakebite, which contains antibodies against the venom, is an example of passive immunity.

Recombinant DNA technology has helped in producing large-scale vaccine production.

The hepatitis-B vaccine is produced from yeast.

Allergies

Immune response to certain environmental antigens, e.g. pollens, dust, mites, etc.

- IgE antibody is produced during an allergic reaction
- Mast cell releases histamine and serotonin during an allergic reaction

Auto Immunity

- When the body attacks self-cells it results in auto-immune disorder.
- Rheumatoid arthritis is an auto-immune disorder

Immune System in the Body

The human immune system comprises lymphoid organs, cells and antibodies

Primary lymphoid organs: These include bone marrow and thymus. Here lymphocytes develop, get mature and are differentiated into antigen-specific lymphocytes.

Secondary lymphoid organs: These organs include spleen, lymph nodes, tonsils in the small intestine and appendix. These are the sites for reaction with antigen.

- The spleen acts as a filter of the blood. It contains lymphocytes, phagocytes also erythrocytes are present.
- Lymph nodes trap the antigens present in the lymph or tissue fluid.

Mucosa-associated lymphoid tissue (MALT): the mucosal lining of respiratory, urinary and digestive tract accounts for the 50% of total lymphoid tissues present in the body.

AIDS (Acquired Immuno Deficiency Syndrome)

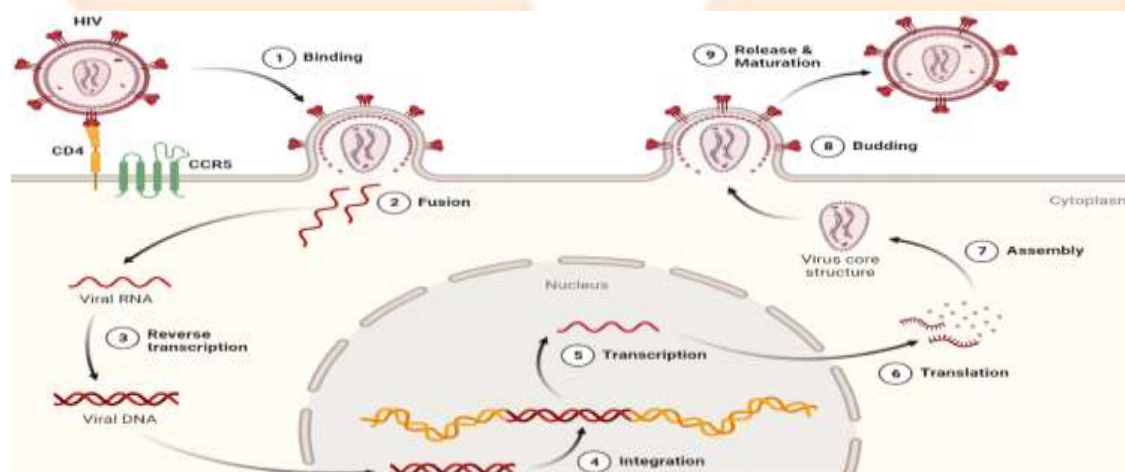


Image: Life cycle of HIV virus

- It is caused by HIV (Human Immunodeficiency Virus) and it is a retrovirus with RNA as its genome.
- The virus produces viral DNA in the host by the enzyme reverse transcriptase.
- The viral DNA gets incorporated into the host genome and multiple copies of the virus are produced.
- The virus attacks helper T-cells, where it replicates and multiplies, resulting in a marked decrease in the number of T lymphocytes.
- The infected person shows weak immunity after the virus attacks T- helper cells.
- AIDS patients become prone to various infections like mycobacterium, toxoplasma, fungal, and other viral infections.
- ELISA (Enzyme-Linked Immuno-Sorbent Assay) is a widely used diagnostic test for AIDS.
- AIDS may be transmitted by sexual intercourse, contaminated blood transfusion, using an infected syringe, or from mother to fetus through the placenta.
- NACO (National AIDS Control Organisation) works for the awareness and prevention of AIDS by educating people and spreading awareness.

Cancer

- Cancer is caused due to uncontrolled cell division leading to the formation of tumours.
- There is a breakdown of regulatory mechanisms in the normal cells.
- Cancerous cells lack contact inhibition property, which inhibits further growth of cells in contact with other cells.

Benign tumours remain at their original location.

Malignant tumours have invading ability and damage surrounding tissues. These are destructive in nature.

Metastasis: It is a property of a malignant tumour when cells sloughed off from it reach distant sites and form a tumour in the various parts of the body.

- Cancer is caused due to DNA damage or genetic mutation resulting in the mismanaged regulation of the cell division.
- Cancer can also happen due to the activation of proto-oncogenes present in normal cells.

- Tumour suppressor genes, also known as anti-oncogenes, control the cell during cell division as well as replication, and if genes fail to function properly, these methods of cell division and replication become uncontrollable, potentially leading to cancer.

Carcinogens: ionising radiation, non-ionising radiation (UV rays), chemical agents (e.g. present in tobacco), viral oncogenes of oncogenic viruses.

- Cancer can be diagnosed by using a CT scan (computed tomography), MRI (magnetic resonance imaging), X-ray, PET scan (positron emission tomography).
- Cancer can also be diagnosed using molecular biology techniques to identify inherited genes which cause cancer.
- Antibodies against cancer antigens can also be used for diagnostic purposes.
- Cancer can be treated by surgery, transplantation and even radiation therapies are quite useful.
- α -interferon act as biological response modifier, which activates the immune system to destroy tumour and also is useful.

Drugs and Alcohol Abuse

- Opioids, cannabinoids and coca alkaloids are commonly abused drugs.
- Diacetylmorphine is commonly known as heroin or smack. It is extracted from the latex of the poppy plant *Papaver somniferum*.
- Cannabinoids bind with the cannabinoid receptors present in the brain. They affect the cardiovascular system.
- Cannabinoids, e.g. marijuana, hashish, charas, ganja, etc. are obtained from the flower tops, leaves.
- Cocaine or coca alkaloid is obtained from the plant *Erythroxylum coca*.
- Cocaine acts by interfering with the transport of dopamine, a neurotransmitter.
- *Atropa belladonna* and *Datura* also have hallucinogenic properties.
- Sportspersons also take cannabinoids to enhance their performance and can practice for long hours thus increasing stamina.
- Morphine is used as a sedative and painkiller.

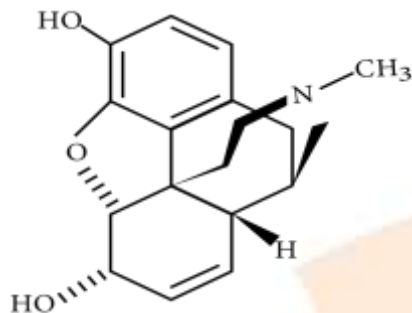


Image: Morphine

- Nicotine (alkaloid) present in tobacco releases adrenaline and nor-adrenalin hormone by the adrenal gland. It increases heart rate and blood pressure.

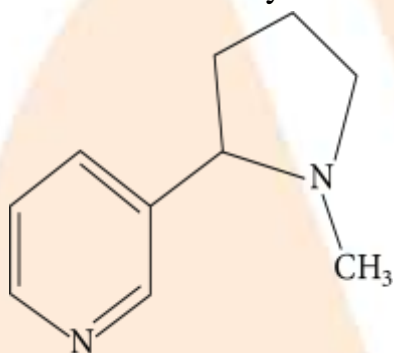


Image: Nicotine

- Smoking causes oxygen deficiency by increasing the concentration of carbon monoxide in the blood thereby decreasing the concentration of oxygen bound to haemoglobin.
- The excessive use of drugs and alcohol damages the nervous system and causes liver cirrhosis so we should avoid them.
- Anabolic steroids make men more masculine and make females more aggressive.

Key points to remember:

- Health is more than simply the absence of disease. It is a perfect state of physical, mental, social, and psychological well-being.
- Typhoid, pneumonia, cholera, fungal infections of the skin, malaria, and other diseases cause significant suffering in humans.
- Malaria and other vector-borne diseases, particularly those caused by *Plasmodium falciparum*, can be fatal if not treated.

- Aside from personal hygiene and cleanliness, public health initiatives such as proper waste disposal, disinfecting drinking water, vector control such as mosquito control, and immunisation are very effective in stopping these diseases.
- When we are subjected to disease-causing agents, our immune system plays a critical role in avoiding these diseases.
- Our bodies' innate defences, such as skin and mucous membranes, as well as antimicrobial substances found in tears and saliva, Phagocytic cells aid in the prevention of pathogen entry into our bodies.
- If pathogens gain entry into our bodies, specific antibodies (humoral immune response) as well as cells (cell mediated immune response) kill them.
- The cells of the immune system have memory. When exposed to the same pathogen again, the immune response is faster and more intense.
- This is the foundation of the protection provided by vaccination and immunisation.
- AIDS and cancer, among other diseases, affect a large number of people worldwide.
- The human immunodeficiency virus (HIV) causes AIDS, which is fatal unless certain steps are taken.
- Many cancers are treatable if detected early and appropriate treatment is administered.
- Drug and alcohol misuse among youth and adolescents has recently increased. Because of the addictive qualities of alcohol and drugs, as well as their perceived benefits such as stress relief, a person may experiment with them in the face of peer pressure, exam-related, and competition-related stresses. As a result, he or she may become addicted to them.
- Individuals would be completely liberated from these evils if they were educated about their harmful effects, counselled, and sought immediate professional as well as medical help.