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7. ENVIRONMENTAL AND NUTRITIONAL DISEASE

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ENVIRONMENTAL AND NUTRITIONAL DISEASES

➢ INTRODUCTION:

This chapter mainly includes air pollution, nutritional disease, effects of starvation and importance of vitamins. Here, Air pollution is the term used to describe any harmful gases in the air we breathe. Pollution can be emitted from natural sources such as volcanoes, but humans are responsible for much of the pollution in our atmosphere. It may produce harmful effects on our health by directly or indirectly. Other important topic is nutritional disease. For our life Proteins, Vitamins and minerals are essential. The deficiency of it or over amount of it as per the requirements leads to several diseases. so it is essential to know the role of these all in our body.

➢ AIR POLLUTION

Definition: "Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or damages the natural environment into the atmosphere.**"**

Air pollutant is known as a substance in the air that can cause harm to humans and the environment. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made.

Pollutants can be classified as either primary or secondary.

1) **Primary pollutants** are substances directly emitted from a process, such as ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust or sulfur dioxide released from factories.
2) **Secondary pollutants** are not emitted directly. Rather, they form in the air when primary pollutants react or interact. An important example of a secondary pollutant is ground level ozone — one of the many secondary pollutants that make up photochemical smog.

1. Major primary pollutants produced by human activity include:

Sulfur oxides (SO_x):

- Especially sulfur dioxide, a chemical compound with the formula SO_2, a colorless gas with a pungent, suffocating odor.
- It is readily soluble in cold water, sparingly soluble in hot water, and soluble in alcohol, acetic acid, and sulfuric acid. It is corrosive to organic materials and dissolves in water to form sulfurous acid, H_2SO_3.
- Sulfur dioxide is used in bleaching and in chemical manufacture and as a refrigerant and a food preservative, e.g., for fumigating fruit.
- It may be produced by reaction of sulfur with oxygen, e.g., by burning sulfur in air, and it is often produced during the roasting of sulfide ores, e.g., in zinc smelting. Sulfur dioxide is a dangerous air pollutant because of its corrosive properties; it irritates the eyes, nose, and lungs.
- It is produced by combustion of coal, fuel oil, and gasoline, since these fuels contain sulfur. The sulfur content of a fuel can be reduced by refining, so that less sulfur dioxide is emitted when the fuel is burned. SO_2 is produced by volcanoes and in various industrial processes. Since coal and petroleum often contain sulfur compounds, their combustion generates sulfur dioxide.
- Further oxidation of SO_2, usually in the presence of a catalyst such as NO_2, forms H_2SO_4, and thus acid rain. This is one of the causes for concern over the environmental impact of the use of these fuels as power sources.

Nitrogen oxides (NO_x):

- Nitric oxide or nitrogen monoxide, a colorless gas formed by the combustion of nitrogen and oxygen as given by the reaction: energy + N_2 + O_2 → 2NO; m.p. -163.6°c; b.p. -151.8°c. Nitric oxide readily combines with oxygen or air to form nitrogen dioxide (NO_2), which can again be separated by ultraviolet light to produce nitric oxide and highly reactive oxygen atoms.
- These oxygen atoms combine with hydrocarbons producing noxious compounds that irritate the membranes of living organisms and destroy vegetation. Large

amounts of nitric oxide are created by internal-combustion engines and manufacturing processes. Its quantity is greatly reduced by passing the oxide gas through a catalyst, thereby converting it back to its constituent nitrogen and oxygen gases.

- In the environment, nitric oxide is a precursor of smog and acid rain. Nitric oxide in minute amounts serves as a source of energy in certain bacteria. In the body, it serves as a chemical messenger with a wide range of functions. It acts as a neurotransmitter and is necessary for penile erection. It affects blood pressure and is produced by macrophages in the immune system to help defend against infection and cancer.
- Despite its usefulness, nitric oxide can have a toxic effect on body cells and has been implicated in Huntington's disease

Carbon monoxide:

- It is a colourless, odourless, non-irritating but very poisonous gas. It is a product by incomplete combustion of fuel such as natural gas, coal or wood.
- Vehicular exhaust is a major source of carbon monoxide. Co produces CNS depressant effects, Systemic asphyxiant.
- Hemoglobin has 200 time greater affinity for CO than oxygen so it produces systemic hypoxia as well as produce unconsciousness and death.
- When Co binds to hemoglobin it produce carboxyhemoglobin which is characterized by red colour of skin and mucus membrane.

Carbon dioxide (CO_2):

- A greenhouse gas emitted from combustion but is also a gas vital to living organisms.
- It is a natural gas in the atmosphere.

Other primary pollutant are Volatile organic compounds, Particulate matter, Persistent free radicals, Toxic metals, such as lead, cadmium and copper, Chlorofluorocarbons (CFCs) - harmful to the ozone layer emitted from products currently banned from use, Ammonia (NH_3)

2. Secondary pollutants include:

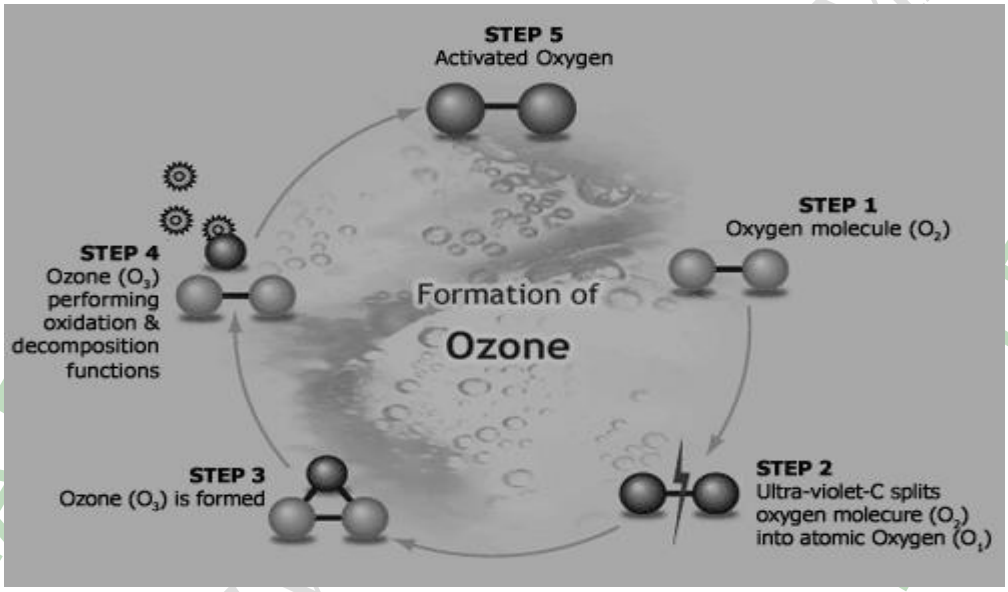
Particulate matter:

- Formed from gaseous primary pollutants and compounds in photochemical smog. Smog is a kind of air pollution; the word "smog" is a portmanteau of smoke and fog. Classic smog results from large amounts of coal burning in an area caused by a mixture of smoke and sulfur dioxide.
- Modern smog does not usually come from coal but from vehicular and industrial emissions that are acted on in the atmosphere by sunlight to form secondary pollutants that also combine with the primary emissions to form photochemical smog.

Ground level ozone (O_3):

- Ozone, an allotropic form of the chemical element oxygen. Pure ozone is an unstable, faintly bluish gas with a characteristic fresh, penetrating odor. The gas has a density of 2.144 grams per liter at STP . Below its boiling point (-112°C) ozone is a dark blue liquid; below its melting point (-193°C) it is a blue-black crystalline solid. Ozone is triatomic oxygen, O_3 , and has a molecular weight of 47.9982 atomic mass units (amu). It is the most chemically active form of oxygen. It is formed in the ozone layer of the stratosphere by the action of solar ultraviolet light on oxygen. Although it is present in this layer only to an extent of about 10 parts per million, ozone is important because its formation prevents most ultraviolet and other high-energy radiation, which is harmful to life, from penetrating to the earth's surface.
- Ultraviolet light is absorbed when its strikes an ozone molecule; the molecule is split into atomic and diatomic oxygen: 0_3 + ultraviolet light $\rightarrow 0+0_2$. Later, in the presence of a catalyst, the atomic and diatomic oxygen reunite to form ozone. Some environmental scientists fear that certain man-made pollutants (e.g., nitric oxide, NO) may interfere with this delicate balance of reactions that maintains the ozone's concentration, possibly leading to a drastic depletion of stratospheric ozone. Ozone is also formed when an electric discharge passes through air; for example, it is formed by lightning and by some electric motors and generators.

- Ozone is produced commercially by passing dry air between two concentric-tube or plate electrodes connected to an alternating high voltage; this is called the silent electric discharge method. Ozone is used commercially as a disinfectant and decontaminant for air and water, and as a bleaching agent for waxes, oils, and other organic compounds. The major commercial use is in the production by ozonolysis of azelaic acid (used in making plastics); it is also used in the synthesis of cortisone and certain synthetic sex hormones.
- Ozonization, the reaction of ozone with the double or triple bonds of unsaturated organic molecules, is useful in determining the structure of organic compounds.



According to Sources can be classified into two major categories which are:

1. **Anthropogenic sources** (human activity) mostly related to burning different kinds of fuel:
    - "Stationary Sources" include smoke stacks of power plants, manufacturing facilities (factories) and waste incinerators, as well as furnaces and other types of fuel-burning heating devices
    - "Mobile Sources" include motor vehicles, marine vessels, aircraft and the effect of sound etc.
    - Chemicals, dust and controlled burn practices in agriculture and forestry management. Controlled or prescribed burning is a technique sometimes

used in forest management, farming, prairie restoration or greenhouse gas abatement. Fire is a natural part of both forest and grassland ecology and controlled fire can be a tool for foresters. Controlled burning stimulates the germination of some desirable forest trees, thus renewing the forest.

- Fumes from paint, hair spray, varnish, aerosol sprays and other solvents
- Waste deposition in landfills, which generate methane. Methane is not toxic; however, it is highly flammable and may form explosive mixtures with air. Methane is also an asphyxiant and may displace oxygen in an enclosed space. Asphyxia or suffocation may result if the oxygen concentration is reduced to below 19.5% by displacement
- Military, such as nuclear weapons, toxic gases, germ warfare and rocketry

2 Natural sources:

- Dust from natural sources, usually large areas of land with little or no vegetation.
- Methane, emitted by the digestion of food by animals, for example cattle.
- Radon gas from radioactive decay within the Earth's crust. Radon is a colorless, odorless, naturally occurring, radioactive noble gas that is formed from the decay of radium. It is considered to be a health hazard. Radon gas from natural sources can accumulate in buildings, especially in confined areas such as the basement and it is the second most frequent cause of lung cancer, after cigarette smoking.
- Smoke and carbon monoxide from wildfires.
- Volcanic activity, which produce sulfur, chlorine, and ash particulates.

- **SMOKING:**

1) Industrial Smoking:

During foggy weather, when little wind was present the smoke produced by the coal would mix with the fog and form smog.

Smoke + Fog = Smog

- The smog made it difficult for people to see and breathe. When power stations, factories, houses and cars emit or smoke pollution into the atmosphere, it contains chemicals known as sulphur dioxide and nitrogen oxides. These chemicals may either fall directly back to the Earth due to gravity (dry deposition), or they may mix with water in the atmosphere (moisture) and form acids.
- Once acids have formed, they can be transported long distances by the wind before being deposited with rain, snow or hail. This is known as wet deposition, and is commonly called Acid Rain Acid Rain has become a world wide problem. In countries such as India and China, there are many power stations and factories that produce a large amount of pollution. This pollution is transported by the wind and deposited in countries such as Nepal, Pakistan and Afghanistan, which lie hundreds of miles away.
- All rain is slightly acidic as it contains dissolved carbon dioxide, a gas found in air. We therefore class unpolluted rain as having a pH of 5.6. Acid rain has been found to have a pH as low as 2.4. Some times acid rain may produce skin cancer.

2) Tobacco Smoking:

- Tobacco is an agricultural product processed from the fresh leaves of plants in the genus *Nicotiana*. Smoking is the most common method of consuming tobacco, and tobacco is the most common substance smoked. The agricultural product is often mixed with other additives. The resulting vapors are then inhaled and the active substances absorbed through the alveoli in the lungs.
- There are so many product are available in market to inhale tobacco like as Beedi, Cigarette, Electronic cigarette, Hookah, Passive smoking, Pipe smoking, Roll-Your-Own, Vaporizer etc.

- The inhaled substances trigger chemical reactions in nerve endings. The cholinergic receptors are often triggered by the naturally occurring neurotransmitter acetylcholine. Acetylcholine and Nicotine express a chemical similarity, which allows Nicotine to trigger the receptor as well which heighten heart rate, memory, alertness, and reaction time. Dopamine and later endorphins are released, which are often associated with pleasure in occasional smoker but it produce depressant in daily smoker due to desensitization receptors.
- Men are more likely to smoke than women, though the gender gap declines with younger age. The poor are more likely to smoke than the wealthy, and people of developing countries than those of developed countries.
- Usually during the early stages, smoking provides pleasurable sensations, serving as a source of positive reinforcement. After an individual has smoked for many years, the avoidance of withdrawal symptoms and negative reinforcement become the key motivations to continue.
- Tobacco use leads most commonly to diseases affecting the heart and lungs, with smoking being a major risk factor for heart attacks, strokes, chronic obstructive pulmonary disease (COPD), emphysema, and cancer (particularly lung cancer, cancers of the larynx and mouth, and pancreatic cancer).
- For the public beneficial many governments have introduced excise taxes on cigarettes in order to reduce the consumption of cigarettes as well as Tobacco advertising, Tobacco packaging warning messages, Smoking ban, and Smoking ban in private vehicles.

➢ PROTEIN CALORIE MALNUTRITION:

Definition: "Inadequate consumption of protein and energy as result of primary dietary deficiency or conditioned deficiency may cause loss of body mass and adipose tissue known as protein calorie or protein energy malnutrition."

This deficiency produce marked effects in infants and children. It is well describe by;

1) **Kwashiorkor:**
   - Related to protein deficiency but calorie intake is sufficient.
   - Clinically it is characterized by apathy, edema, subcutaneous fat deposition, moon face, enlarged fatty liver and low serum albumin.
   - Possible pathogenesis of edema are hypoproteinemia or electrolyte imbalance.
   - Other future includes 'flaky-point' areas of skin hyper pigmentation or depigmentation, dusky erythemia, alter and thin texture of hair with flag sign (presence of bands of depigmentation in tuffs of hairs) and anemia.
2) **Marasmus:**
   - Starvation in infant due to overall lack of calories.
   - Marasmic children show stunted growth, total loss of subcutaneous fat, atrophy of muscles, broomstick arm and leg, hanging loose skin and pinched faces.
   - They have no edema or enlarge liver.

CONTRASTING FEATURES OF KWASHIORKOR AND MURASMUS

Definition	▪ Protein deficiency with sufficient calorie intake	▪ Starvation in infants with over all lack of calories
Clinical Features	▪ Occur in children between 6 months and 3 years of age. ▪ Growth Failure. ▪ Wasting of muscles but preserved adipose tissue. ▪ Oedema generalized or localized ▪ Enlarge fatty liver ▪ Serum Protein low ▪ Anemia Present ▪ "Flag Sign"- alternate band of light (depigmented) and dark (pigmented) hair.	▪ Common in infants with under 1 year of age. ▪ Growth Failure. ▪ Wasting all tissue including muscles and adipose tissue. ▪ Oedema absent. ▪ No hepatic enlargement. ▪ Serum Protein low ▪ Anemia Present ▪ Monkey like face , protuberant abdomen, thin limbs
Morphology	▪ Enlarge Fatty liver ▪ Atrophy of different tissues and organs but subcutaneous fat preservation	▪ No fatty liver ▪ Atrophy of different tissue and organs including subcutaneous fat

➢ PATHOGENESIS OF STARVATION:

Starvation is an over all deficiency of nutrition. It is due to;

1) **Deliberate (Intentional) fasting:** Religious or Political.
2) **Famine (food crisis)** condition in a country or community.
3) Secondary under nutrition such as due to **chronic wasting disease** (infection, inflammatory conditions, liver disease), cancer etc.

A starved person has lax, dry skin, wasted muscles and atrophy of internal organs.

The following metabolic changes observed in starvation:

1) Glucose:

- Glucose stores of the body are sufficient for one day's metabolic needs only.
- During Fasting State, insulin independent tissue such as the brain, blood cells and renal medulla continue to utilize glucose.
- While insulin dependent tissues like muscle stop taking up glucose.
- This results in release of glycogen store of the liver to maintain normal blood glucose level means storage glycogen in to liver convert in to glucose.
- Subsequently, hepatic gluconeogenesis from other sources such as breakdown of proteins takes place.

2) Proteins:

- Protein stores and the triglycerides of adipose tissue have enough energy for about 3 months in an individual.
- Proteins breakdown to release amino acids which are used as fuel for hepatic gluconeogenesis so as to maintain glucose need of brain.
- This results in nitrogen imbalance due to excretion of nitrogen compounds as urea.

3) **Fats:**

- After about one week of starvation, protein breakdown is decrease while triglycerides of adipose tissue breakdown to form glycerol and fatty acids.
- The fatty acids are converted in to ketone bodies in the liver which are used by most organs including brain in place of glucose.
- Starvation can then continue till all the body fat stores are exhausted following with death occur.

Briefs Summary of starvation:

- In to the starvation glucose level gets decreased but glucose is essential for the metabolic need of each and every organs. During this condition stored glucose is utilized to provide the energy for metabolic function of various organs in starvation.
- First glucose need is fulfill by conversion of glycogen to glucose but it have capacity to provide glucose for one day.
- Then glucose need is fulfill by protein, protein gets breakdown and it is utilize for the gluconeogenesis which produce glucose.
- Finally after the week of starvation the metabolic need is fulfill by triglycerides which is fat stored in adipose tissues gets break down to form glycerol and fatty acid. In this time, brain used ketone bodies in place of glucose.
- If the starvation is continue after this period death will occur in some cases.

➢ VITAMIN:

Definition: "A **vitamin** is an organic compound required as a nutrient in tiny amounts by an organism**"**

- There are two types of vitamis one is fat soluble and other is water soluble.
- Vitamins A, D, E and K are **fat soluble** while Vitamins B complex and C are **water soluble**.
- Vitamins are classified by their biological and chemical activity, not by their structure. Thus, each "vitamin" refers to a number of *vitamer* compounds that all show the biological activity associated with a particular vitamin. Such a set of chemicals are grouped under an alphabetized vitamin "generic descriptor" title, such as "vitamin A", which includes the compounds retinal, retinol, and four known carotenoids.
- Vitamers by definition are convertible to the active form of the vitamin in the body, and are sometimes inter-convertible to one another, as well.

1) Vitamin A (Retinol):

- Vitamin A can be found in two principal forms in foods Retinol and carotenes.
- The role of vitamin A in the vision cycle is specifically related to the retinal form. Within the eye, 11-*cis*-retinal is bound to rhodopsin (rods) and iodopsin (cones) at conserved lysine residues. Rhodopsin is needed to see black and white as well as see at night. It is for this reason that a deficiency in vitamin A will inhibit the reformation of rhodopsin and lead to night blindness.
- Vitamin A, in the retinoic acid form, plays an important role in gene transcription. Once retinol has been taken up by a cell, it can be oxidized to retinal (by retinol dehydrogenases) and then retinal can be oxidized to retinoic acid (by retinal oxidase). The conversion of retinal to retinoic acid is an irreversible step, meaning that the production of retinoic acid is tightly regulated, due to its activity as a ligand for nuclear receptors. Retinoic acid can bind to two different nuclear receptors to initiate (or inhibit) gene transcription: the retinoic acid receptors

(RARs) or the retinoid "X" receptors (RXRs). So it is useful for gene transcription.

Deficiency:

- Vitamin A deficiency can occur as either a primary or a secondary deficiency.
- A primary vitamin A deficiency occurs among children and adults who do not consume an adequate intake of yellow and green vegetables, fruits, and liver. Early weaning can also increase the risk of vitamin A deficiency.
- Secondary vitamin A deficiency is associated with chronic malabsorption of lipids, impaired bile production and release, low fat diets, and chronic exposure to oxidants, such as cigarette smoke.
- Zinc deficiency can also impair absorption, transport, and metabolism of vitamin A because it is essential for the synthesis of the vitamin A transport proteins and the oxidation of retinol to retinal.
- Vitamin A deficiency is impaired vision, particularly in reduced light - night blindness.

Toxicity:

- Excesses taken in through diet lead to nausea, jaundice, irritability, anorexia, vomiting, blurry vision, headaches, hair loss, muscle and abdominal pain and weakness, drowsiness, and altered mental status.
- Cell culture studies have linked increased bone resorption and decreased bone formation with high vitamin A intakes.
- The carotenoid forms (such as beta-carotene as found in carrots), give no such symptoms, but excessive dietary intake of beta-carotene can lead to carotenodermia, which causes orange-yellow discoloration of the skin.

Functions of vitamin A (Retinol):

- Maintenance of normal vision in dim light: Oxidation of retinol produce two pigment rhodopsin and iodopsin, in eye two types of cells are present rod cell and

cone cell. Rhodopsin formed in Rod cells which are responsible for to view in dim light. While idopsin formed in Cone cells are responsible for to view in bright light. These both pigments adjust the bright view and light view by converting radiant energy in to nerve impulses.

- It is necessary for maintaining the integrity and the normal function of glandular and epithelial tissue which lines intestinal, respiratory, urinary tracts as well as skin and eye.
- It supports growth especially skeletal growth.
- It is anti-infective means deficiency of it reduces the immune power and increases the chances of infection.
- Newly it is suggested that it may protect against several cancer.

2) Vitamin B complex:

The **B vitamins** are water-soluble vitamins that play important roles in cell metabolism. They are available in various forms like Vitamin B_1, B_2, B_3, B_5, B_6, B_7, B_8, B_9, and B12.

Deficiency:

- **Vitamin B1:** Deficiency causes beriberi. Symptoms of this disease include weight loss, emotional disturbances, Wernicke's encephalopathy (impaired sensory perception), weakness and pain in the limbs, periods of irregular heartbeat, and edema (swelling of bodily tissues). Heart failure and death may occur in advanced cases. Chronic thiamine deficiency can also cause Korsakoff's syndrome, an irreversible psychosis characterized by amnesia and confabulation.
- **Vitamin B_2:** Deficiency causes ariboflavinosis. Symptoms may include cheilosis (cracks in the lips), high sensitivity to sunlight, angular cheilitis, glossitis (inflammation of the tongue), seborrheic dermatitis or pseudo-syphilis (particularly affecting the scrotum or labia majora and the mouth), pharyngitis, hyperemia, and edema of the pharyngeal and oral mucosa.

- **Vitamin B_3:** Deficiency, along with a deficiency of tryptophan causes pellagra. Symptoms include aggression, dermatitis, insomnia, weakness, mental confusion, and diarrhea. In advanced cases, pellagra may lead to dementia and death.
- **Vitamin B_5:** Deficiency can result in acne and paresthesia, although it is uncommon.
- **Vitamin B_6:** Deficiency may lead to microcytic anemia (because pyridoxyl phosphate is the cofactor for heme synthesis), depression, dermatitis, high blood pressure (hypertension), water retention, and elevated levels of homocysteine.
- **Vitamin B_7:** Deficiency does not typically cause symptoms in adults but may lead to impaired growth and neurological disorders in infants. Multiple carboxylase deficiency, an inborn error of metabolism, can lead to biotin deficiency even when dietary biotin intake is normal.
- **Vitamin B_9:** Deficiency results in a macrocytic anemia. Deficiency in pregnant women can lead to birth defects. Supplementation is often recommended during pregnancy. Researchers have shown that folic acid might also slow the insidious effects of age on the brain.
- **Vitamin B_{12}:** Deficiency results in a macrocytic anemia, elevated homocysteine, peripheral neuropathy, memory loss and other cognitive deficits. It is most likely to occur among elderly people, as absorption through the gut declines with age; the autoimmune disease pernicious anemia is another common cause. It can also cause symptoms of mania and psychosis. In rare extreme cases, paralysis can result.

Toxicity:

- **Vitamin B_1:** No known toxicity from oral intake. There are some reports of anaphylaxis caused by high-dose thiamin injections into the vein or muscle.
- **Vitamin B_2:** No evidence of toxicity. Produce reactive oxygen species when riboflavin was exposed to intense visible and UV light.
- **Vitamin B_3:** Flushing (redness of the skin, often accompanied by itching or a mild burning sensation).
- **Vitamin B_5:** No known toxicity.

- **Vitamin B_6:** Sensory neuropathy and dermatological lesions.
- **Vitamin B_7, B_{12} & B_9:** No known toxicity.

Functions of Vitamin B complex:

- **Vitamin B1 (Thiamine)** after the absorption converts in to thiamine pyrophosphate by phosphorylation process. Which act as coenzyme for carboxylase for the production of ATP.
- **Vitamin B2 (Riboflavin)** is also known as cytochrom oxidase essential for cellular oxidation process.
- **Vitamin B3 (Niacin/Nicotinic acid)** is essential for the metabolism of carbohydrates, proteins and fat.
- **Vitamin B6 (Pyridoxine)** is essential for fat, protein and steroid metabolism as well as for synthesis of neurotransmitters and heam.
- **Vitamin B12 (Folate and cyanocobalamin)** is essential for gene expression, gluconeogenesis, fatty acid synthesis, catabolism of certain amino acids and carrier of CO2 in carboxylase enzyme.

3) Vitamin C (Ascorbic Acid):

- Vitamin C or L-ascorbic acid or L-ascorbate is an essential nutrient for humans.
- Vitamin C is purely the L-enantiomer of ascorbate; the opposite D-enantiomer has no physiological significance. Both forms are mirror images of the same molecular structure.
- In living organisms, ascorbate is act as an anti-oxidant, since it protects the body against oxidative stress.
- Vitamin C supplementation significantly reduced the frequency of the common cold.
- Ascorbic acid is absorbed in the body by both active transport and simple diffusion. Sodium-Dependent Active Transport - Sodium-Ascorbate Co-Transporters (SVCTs) and Hexose transporters (GLUTs) - are the two transporters required for absorption.

Deficiency:

- Deficiency of vitamin C produces scurvy. Scurvy leads to the formation of brown 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 scurvy there are open, suppurating wounds and loss of teeth and, eventually, death.
- Smokers who have diets poor in vitamin C are at a higher risk of lung-borne diseases than those smokers who have higher concentrations of vitamin C in the blood.

Toxicity:

- There are no documented toxicity effects for vitamin C in relation to food and diet.
- At high supplemental doses involving 5 or more grams of vitamin C, diarrhea can result from the fluid in the intestine becoming too concentrated ("osmotic diarrhea").
- Large supplemental doses of vitamin C can also increase levels of uric acid in the urine, because vitamin C can be broken down into uric acid which increases the chances for kidney stones.

Functions of Vitamin C (Ascorbic Acid):

- It has anti oxidant properties so it prevents formation of free radicals.
- By the help of it prolin convert to hydroxyprolin which is essential component of collagen.
- It is useful for hydroxylation of dopamine to norepinephrine.
- Useful to prevent common cold.
- Gives protection against certain infections
- Facilitate the absorption of iron from vegetables.

4) Vitamin D (Calcitriol):

- Vitamin D is a group of fat-soluble secosteroids, the two major physiologically relevant forms of which are vitamin D_2 (ergocalciferol) and vitamin D_3 (cholecalciferol). Vitamin D_3 is produced in the skin of vertebrates after exposure

to ultraviolet B light from the sun or artificial sources, and occurs naturally in a small range of foods. Vitamin D is carried in the bloodstream to the liver, where it is converted into the prohormone calcidiol. Circulating calcidiol may then be converted into calcitriol, the biologically active form of vitamin D, either in the kidneys or by monocyte-macrophages in the immune system.

- When synthesized by monocyte-macrophages, calcitriol acts locally as a cytokine, defending the body against microbial invaders.
- When synthesized in the kidneys, calcitriol circulates as a hormone, regulating, the concentration of calcium and phosphate in the bloodstream, promoting the healthy mineralization, growth and remodeling of bone.
- Vitamin D also modulates neuromuscular function, reduces inflammation, and influences the action of many genes that regulate the proliferation, differentiation and apoptosis of cells.

Deficiency:

Deficiency results in impaired bone mineralization, and leads to bone softening diseases including:

- Rickets, a childhood disease characterized by impeded growth and deformity of the long bones which can be caused by calcium or phosphorus deficiency as well as a lack of vitamin D.
- Osteomalacia, a bone-thinning disorder that occurs exclusively in adults and is characterized by proximal muscle weakness and bone fragility.
- Deficiency may produce certain cancers, multiple sclerosis, rheumatoid arthritis, juvenile diabetes, Parkinson's and Alzheimer's disease.

Toxicity:

- Vitamin D overdose causes hypercalcemia and the main symptoms of vitamin D overdose are those of hypercalcemia: anorexia, nausea, and vomiting can occur, frequently followed by polyuria, polydipsia, weakness, nervousness, pruritus, and ultimately renal failure.

- Hypercalcaemia during pregnancy may increase fetal sensitivity to effects of vitamin D and lead to a syndrome of mental retardation and facial deformities.
- Exposure to sunlight for extended periods of time does not normally cause vitamin D toxicity. This is because within about 20 minutes of ultraviolet exposure in light skinned the concentrations of vitamin D precursors produced in the skin reach equilibrium, and any further vitamin D that is produced is degraded.

Functions of Vitamin D (Calcitriol):

- In intestinal, promotes absorption of calcium and phosphors.
- In bone, stimulate normal mineralization and enhance bone resorption.
- In kidney, increase tubular reabsorption of phosphate.
- It shows antiproliferative action on parathyroid cells.

5) Vitamin K:

- Vitamin k have two natural and three synthetic forms vitamins K_3, K_4, and K_5, which are used in many areas including the pet food industry (vitamin K_3) and to inhibit fungal growth (vitamin K_5).
- Within the cell, vitamin K undergoes electron reduction to a reduced form of vitamin K (called vitamin K hydroquinone) by the enzyme vitamin K epoxide reductase.

  Another enzyme then oxidizes vitamin K hydroquinone to allow carboxylation of Glutamate to Glaycine; this enzyme is called the gamma-glutamyl carboxylase or the vitamin K-dependent carboxylase.

  The carboxylation reaction will only proceed if the carboxylase enzyme is able to oxidize vitamin K hydroquinone to vitamin K epoxide at the same time; the carboxylation and epoxidation reactions are said to be coupled reactions.

  Vitamin K epoxide is then re-converted to vitamin K by vitamin K epoxide reductase. These two enzymes comprise the so-called vitamin K cycle. One of the

reasons humans are rarely deficient in vitamin K is that vitamin K is continually recycled in our cells.

Deficiency:

- Average diets are usually not lacking in vitamin K and primary vitamin K deficiency is rare in healthy adults.
- Deficiency mainly seen in who suffer from liver damage or disease (e.g. alcoholics), people with cystic fibrosis, inflammatory bowel diseases or those who have recently had abdominal surgeries.
- Several drugs may also produce the deficiency of Vitamin K like as salicylates, barbiturates, and cefamandole, although the mechanism is still unknown.

Toxicity:

- There is no known toxicity associated with high doses of the phylloquinone (vitamin K_1) or menaquinone (vitamin K_2) forms of vitamin K and therefore no tolerable upper intake level (UL) has been set.
- But some times allergic reaction from supplementation is possible.

Functions of vitamin K:

- Essential for coagulation process.

6) Vitamin E (α-Tocopherol):

- Vitamin E is a generic term for tocopherols and tocotrienols.
- Naturally occurring vitamin E exists in eight chemical forms (alpha-, beta-, gamma-, and delta-tocopherol and alpha-, beta-, gamma-, and delta-tocotrienol) that have varying levels of biological activity. But Alpha- (or α-) tocopherol is the only form that is recognized to meet human requirements.
- vitamin E is involved in immune function, cell signaling, regulation of gene expression, and other metabolic processes

- Vitamin E is a fat-soluble antioxidant that stops the production of reactive oxygen species formed when fat undergoes oxidation.

Deficiency

Vitamin E deficiency can cause:

- Premature babies of very low birth weight (<1,500 grams) might be deficient in vitamin E.
- Deficiency symptoms include peripheral neuropathy, ataxia, skeletal myopathy, retinopathy, and impairment of the immune response.

Toxicity:

- Vitamin E has no any adverse effects from consuming in food.
- However, high doses of α -tocopherol supplements can cause hemorrhage and interrupt blood coagulation, and high doses inhibit platelet aggregation.

Functions of Vitamin E (α-Tocopherol):

- It prevents the degradation of cell because it has anti oxidant properties.
- Inhibit the formation of free radicals so maintain the integrity of cells.
- Inhibit the prostaglandin synthesis.
- Inhibits the activity of protein kinase C, an enzyme involved in cell proliferation and differentiation in smooth muscle cells, platelets, and monocytes
- Suppress arachidonic acid metabolism, dilates blood vessels and inhibits platelet aggregate.

7. ENVIRONMENTAL AND NUTRITIONAL DISEASE

BELOW TABLE SHOWS BRIEF SUMMARY OF VITAMINS

Vitamins	Food Source	Deficiency disease	Symptoms of deficiency	Recommended dietary allowances (male, age 19–70)
Vitamin A (Retinol)	Cod liver oil, carrots, Milk, butter, eggs, liver, margarine, tomatoes,	Night-blindness and Keratomalacia	Susceptibility to infection; poor vision in twilight, Retarded growth	900 µg
Vitamin B_1 (Thiamine)	Rice bran, Meat, especially pork, wholemeal bread and cereals, milk, vegetables	Beriberi, Wernicke-Korsakoff syndrome	Loss of appetite; nerve disorders; fatigue; poor digestion Retarded growth	1.2 mg
Vitamin B_2 (Riboflavin)	Meat, milk, green vegetables, eggs, poultry	Ariboflavinosis	Sores at corners of the mouth; other skin and membrane disorders	1.3 mg
Vitamin B_3 (Niacin)	meat, eggs, grains	Pellagra	Dermatitis, Diarrhea, Dementia	16.0 mg
Vitamin B_5 (Pantothenic acid)	Meats, whole grains, in many foods	Paresthesia	Numbness and tingling of skin	5.0 mg
Vitamin B_6 (Pyridoxine)	Meat, dairy products.	Anemia, peripheral neuropathy.	Vogues lesion produce convulsion in infants, dermatitis, cheilosis, glossitis	1.3–1.7 mg
Vitamin B_7 (Biotin)	Meats, dairy products, eggs	Dermatitis, enteritis		30.0 µg
Vitamin B_9 (Folic acid)	Leafy green vegetables	Megaloblastic anemia	Deficiency during pregnancy is associated with birth defects, such as neural tube defects	400 µg
Vitamin B_{12} (Cobalamins)	Liver, eggs, animal products	Megaloblastic anemia		2.4 µg
Vitamin C (Ascorbic acid)	Citrus, most fresh foods, especially the citrus group, and vegetables, tomatoes, melon	Scurvy	Slow healing; tendency to bruise and bleed easily; sore gums	90.0 mg
Vitamin D (Calciferol)	Fish liver oils, liver, fortified milk and baby cereals, irradiated margarines, etc., sunshine	Rickets and Osteomalacia	Poor bone and tooth development; dental decay; Rickets	5.0 µg–10 µg
Vitamin E (Tocopherol)	Wheat germ oil, unrefined vegetable oils	Deficiency is very rare; mild hemolytic anemia in newborn infants	Infertility	15.0 mg
Vitamin K (Phylloquinone/ phytolnaphthoquinone)	Leafy green vegetables, Meat, poultry, fish, potatoes, peanuts; whole grain cereals	Bleeding diathesis	Faulty clotting of the blood Bleeding	120 µg

➢ OBESITY:

Definition: "it is a condition in which an excess of fat has accumulated." Or "an excessive of body weight that is over the ideal."

But here the problem is that what is mean by excess or ideal therefore obesity is mainly define in to new unit which is body mass index (BMI).

BMI= Body Mass (kg) / Height ^{2} (meter)

The index for body mass is given below;

Body Mask Index Associate Disease Risk		
Obesity Class	**BMI (kg/m^2)**	**Risk**
Underweight	**<18.5**	**Increased**
Normal	**18.5-24.9**	**Normal**
Overweight	**25.0-29.9**	**Increased**
Obesity	**30.0-34.9** **35.0-39.9**	**High** **Very High**
Extreme obesity	**>39.9**	**Extremely High**

Obesity is a malfactorial disorder of energy balance in which chronic calorie intake is greater than energy output.

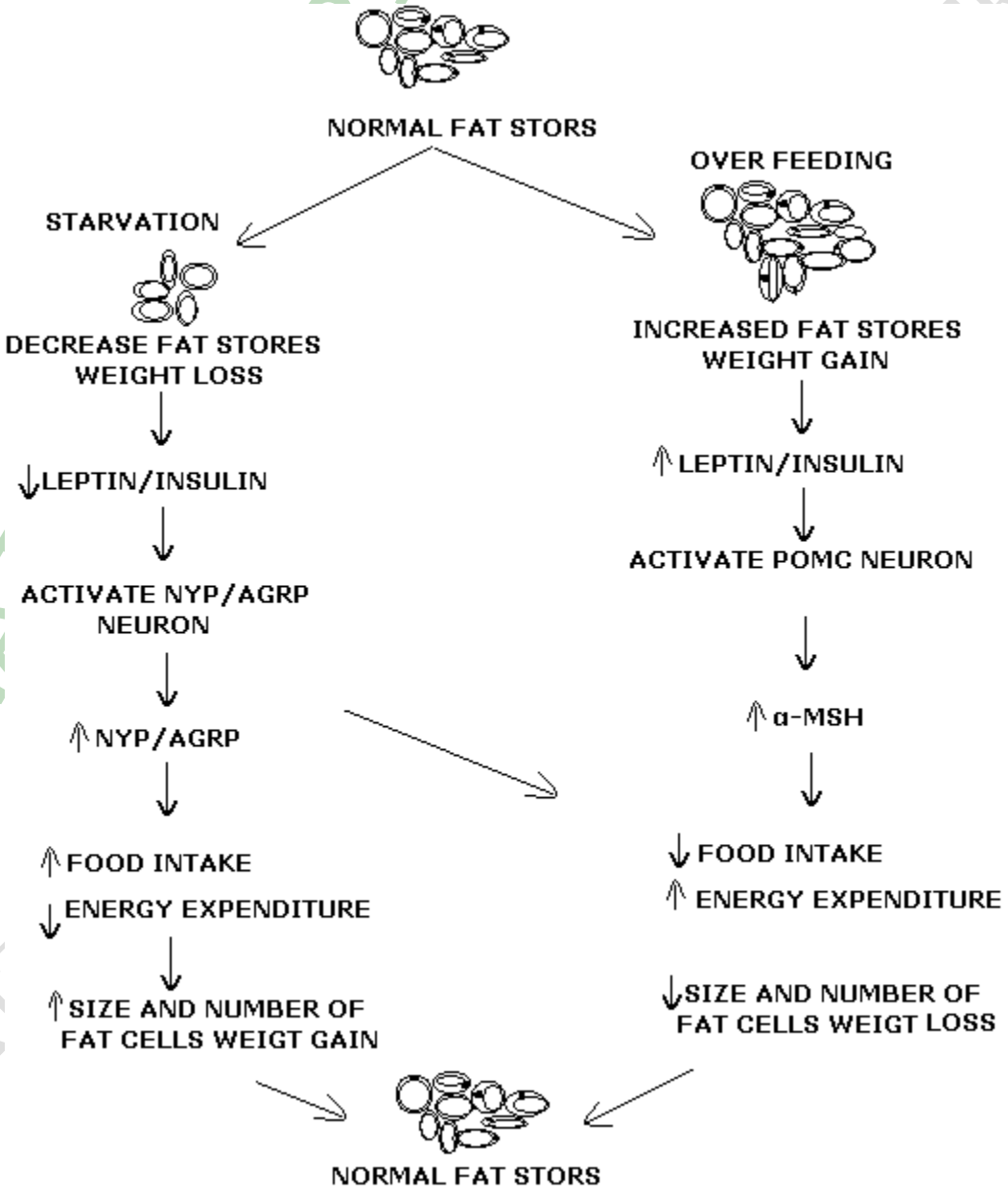
Pathophysiology:

- Leptin and Insulin receptors play a main role in obesity but leptin play a main role.
- Leptin and Insulin level decrease, increase food intake so increase the weight
- Leptin and Insulin level increase, decrease food intake so decrease the weight.
- Hypothalamus contains two groups of receptors where leptin and insulin get binds and gives their action so hypothalamus is the main control system in the obesity. These two groups of receptors are;

2) Neuropeptide Y (NPY) and agouti-related protein (AGRP) in group.

3) Prepro-opiomelanocortin (POMC) which release α-melanocyte-stimulating hormone (α-MSH)

- When fall in the leptin levels activation of the first group, which increase the food intake and decrease the energy expenditure.
- When increase the leptin level due to overfeeding activation of second group, which decrease the food intake and increase the energy expenditure (utilization).



- Other factors involved include;

a) **The stimulators of feeding behavior:** Melanin-concentrating hormone (MCH), Orexin A and B, Galanin, Gama-amino butyric acid (GABA), Growth hormone releaseing hormone (GHRH).

b) **The stimulators of feeding behavior:** Corticotrophin-releasing hormone (CRH), TNF-α, Interlukin-β, 5-hydroxytryptamine, Glucagon like peptide etc.

Obesity increases the risk several conditions or several disease increase the risk of obesity are given below:

1) **Hyperinsulinaemia:** Increase the insulin secretion is a feature of obesity.
2) **Type 2 Diabetes mellitus:** obesity is increase in diabetic state.
3) **Hypertension:** obesity increases the risk of hypertension due to increase blood volume.
4) **Atherosclerosis:** Obesity develops atherosclerosis due to deposition of fat.
5) **Nonalcoholic Fatty liver Disease:** Risk is higher in obese person.
6) **Hypoventilation syndrome:** this is characterized by hypersomnolence, both at night and during day in obese individual along with hypoxia, heart failure etc
7) **Osteoarthritis:** it is most in over weight person.
8) **Cancer:** Higher in person who diet food containing more amount of fat particularly derived from animal fats and meats.
9) **Hyperlipoproteinaemia:** Total cholesterol level is increase with increasing amount of low density of lipoprotein (LDL) and very low density of lipoprotein (VLDL).