WATER

Water is an essential nutrient. The body is made up of 55 to 75 percent water. Fat tissue contains less water than muscle tissue.

Without it, human life cannot survive. Water deprivation kills faster than lack of any other nutrient. One can remain without food for over a month but without water for only a few days. Water is present in the cells, known as intracellular water (2/3), and present outside the cells known as extracellular water(1/3).

FUNCTIONS OF WATER:

1. **Water is a universal solvent:** Water present in or as part of the blood system dissolves minerals, like calcium and magnesium in solution, making them available to the body tissues where they are required for vital functions.
2. **Water serves as the body's transportation system**. It is the medium by which other nutrients and essential elements are carried to the cells. Without this transport of supplies, the body factory would stop. Water is a part of all body fluids. Blood has 90% water and urine has 97% water. Water also works as the transport for body waste removal carrying waste to the lungs or kidneys for excretion..
3. **Water is a lubricant**. The presence of water in and around body tissues helps defend the body against shock. The brain, eyes, and spinal cord are among the body's sensitive structures that depend on a protective water layer. Water is present in the mucous and salivary juices of our digestive systems. This is especially important for making the food soft and moving food through the digestive tract. Persons who experience reduced salivary output soon will realize that foods taste differently and are harder to swallow. As a lubricant, water also is helpful for the smooth movement of bone joints. It is present as synovial fluid.
4. **Water participates in the body's biochemical reactions.** The digestion (hydrolysis/ breakdown) of protein and carbohydrates to usable and absorbable forms depends on water as part of the chemical reaction.
5. **Water regulates body temperature.** Our health and well-being are dependent on keeping our body within a very narrow range (normal 98.6 degrees F). The human body, which is made of 60-75 percent water, serves this function quite well. Evaporation of water from body surfaces removes heat and helps cool the body. 1 liter of perspiration dissipates 600 kcal of heat. Sweat loss that is barely noticeable occurs every day and night. In hot, humid weather or during exercise, increased sweating and losses of water are more visible.
6. **Source of vitamins and minerals**: minerals are all carried in the fluid portions of foods.
7. **Growth:** water is an essential component of every cell. Therefore there is a formation of new cells water is required.

WATER BALANCE

As the body can't store water, we need fresh supplies every day to make up for losses from lungs, skin, urine, and feces. Each day water losses are balanced with water intake. The body has a sophisticated system that works to maintain water balance. Few of us ever experience malfunctioning of this system. Thirst is a trigger that reminds us to take in more water. At the same time, our kidneys regulate urinary output.

There isn't a specific daily recommendation for water intake. An easy way to calculate the requirement is 1 ml of water per kcal consumed. It depends on the climate where one lives, physical activity, age, state of health, and body size. Under normal circumstances, adults may replenish water loss by drinking up to six or eight cups of fluid each day (minimum 2 litres).

Water losses in urine account for about three-fourths of daily losses. The remaining losses come from sweat, as tiny water droplets in the air we exhale, and through feces.

WATER SOURCES:

Water comes from a variety of sources:

1. All beverages or fluids are a source of water. Fluids include fresh water and all other liquids like juice, soft drinks, coffee, tea, milk, and soup.
2. Even solid foods contain water. Vegetables and fruits are composed of 90 percent or more water. Protein-rich foods such as meat, fish, or chicken may contain as much as half to two-thirds of their weight in water. Even cereals, pulses, and dals contain some water. Fats, such as butter or margarine, and sugar are among the foods that contain the least water. Also, water added to cook food contributes to the source.
3. Some water, perhaps one to two cups per day, comes from inside our bodies as a by-product of energy metabolism. This amount is small but significant. This is called metabolic water. 1 gm of CHO gives 0.6 gm of water, 1 gm of fat gives 1.07 gm of water and 1 gm of protein gives 0.41 gm of water.

SPECIAL NEEDS:

Under special circumstances, fluid intake and output should be more carefully monitored. Examples of special circumstances are:

Infants, young children, and old people: Children have lower sweating capacity than adults. They tolerate high temperatures less efficiently. Frequent vomiting and severe diarrhea in infants and young children quickly can lead to water dehydration. Old people may be at increased risk for dehydration because their thirst mechanism may not be as efficient as at younger ages. The influence of medications and the presence of disease are other factors that affect fluid intake and water balance.

Athletes: Of all nutritional concerns for athletes, the most critical is adequate water intake. The athlete's immediate need for water is to control body temperature and cool working muscles. Lack of water, above all other nutrients, has the ability to hinder performance and lead to serious complications. For example, fluid loss of 2 to 3 percent of body weight by sweating impairs performance. Fluid losses of 7 to 10 percent of body weight result in heat stroke and death.

Dehydration occurs when the water content of the body is too low i.c. water output is greater than intake. Symptoms are seen when 5-10% of body water is lost. This is easily fixed by increasing fluid intake. Symptoms of dehydration include headaches, lethargy, mood changes, slow responses, dry nasal passages, dry or cracked lips, dark-colored urine, weakness, tiredness, confusion, and hallucinations. Eventually, urination stops, the kidneys fail and the body can't remove toxic waste products. In extreme cases, this may result in death. Causes of dehydration include:

- Increased sweating due to hot weather, humidity, exercise, or fever.
- Not drinking enough water.
- Insufficient signaling mechanisms in the elderly, sometimes they do not feel thirsty even though they may be dehydrated.
- Diarrhea or vomiting.

Loss of 20% or more of water can lead to death.

INTRODUCTION

Food - is that which nourishes the body; it may also be defined as anything eaten or drunk which can be absorbed by the body to be used as an energy source, bodybuilding, regulating o synthesizing the protective material. Intake of the right kind and amount of food must satisfy hunger and fulfill physiological, psychological, social, and sensory needs. It also protects the body from diseases. Foods contain substances called nutrients that are necessary for growth, survival, and different processes of the body.

Nutrients - are the constituents in food that must be supplied to the body in suitable amounts. These include carbohydrates, fats, proteins, minerals, vitamins, and water.

Nutritious Food - Nutritious food is that which can fulfill the primary functions of food. It provides sufficient energy and essential nutrients, helps in the maintenance of all biological processes of the body, maintains body weight, and protects from the invasion of harmful microorganisms and the onset of any disease.

Functions of food - from the nutritional point of view, food must provide nourishment for:

- Maintenance of life
- Growth and development
- Functioning of vital organs
- Production of energy
- Protection of body

Physiological functions of food -

- Provision of energy for voluntary and involuntary activities of the body
- Helps in the process of growth and development
- Maintenance and repair - required for the maintenance of cells and to replace the worn-out cells e.g. RBCs have a limited life span. Once they die out a replacement is required. In case of injuries also a repair or a replacement may be needed.
- Maintenance of body temperature
- Maintenance of acid-base balance
- Support the functions of the hormones and neurotransmitters
- Removes metabolic waste products from the disorder
- Protection of the body from infection, injuries, and other related diseases

Psychological functions of food -

- Satisfy hunger and taste buds
- Acts as a means of expression of love, affection, and security e.g. a mother express love by cooking favorite dishes of people at home
- Provides enjoyment
- Provide comfort in depressive mood
- Used as a reward/ punishment

Social functions of food -

- Creates an atmosphere for joyful eating
- Helps improve the social relationship
- Used as an offering to God during religious functions and fasts
- The main component of any gathering or party e.g wedding
- Means of communication and relationship e.g. used as a token of friendship
- Means of social prestige

Nutrients - are the constituents in food that must be supplied to the body in suitable amounts. They play a critical role in health, nutrition, and disease. The deficiency of nutrients in diet may have an adverse effect on health. Re-addition of missing nutrients in the diet can help ensure optimum health. Nutrients in food are classified as either macronutrients or micronutrients. These include carbohydrates, fats, proteins, minerals, vitamins, and water.

Nutrition - Nutrition is the science of food and its components, their actions, interaction, and balance within the body. It includes the study of the processing of food within the body such as digestion, absorption, transport, function, and disposal of end products; for its utilization for:

- Provision of energy
- Building of body tissue and their repair
- Protection from microorganisms, heat, and other stressors

The study of nutrition helps to make healthy food choices by understanding the following:

- The role of different nutrients in the body
- The nutritive value of foods
- Which foods are nutritious and healthy
- The RDA for different life stages
- What can happen if the right type and amount of food is not eaten
- How to design nutritious recipes
- How different processing methods can alter the nutritional quality of food
- Role of food and nutrition in health and disease

Adequate, Optimum, Normal, or Good Nutrition - they are all terms used to indicate that the supply of essential nutrients is correct in amount and proportion in accordance with an individual's requirement. It also plies the utilization of these nutrients in the body in such a way that the highest level of physical and mental health is maintained throughout the life cycle.

Malnutrition - Malnutrition is an undesirable state of health resulting from an imbalance of nutrient intake. It has been defined as a pathological state resulting from a relative or absolute deficiency or excess of one or more essential nutrients. The WHO defines malnutrition as 'the cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions. It comprises four forms:

1. Undernutrition - is a condition that results when, over an extended period of time, food intake in terms of quantity and nutritional quality is not adequate enough to meet the dietary and nutritional requirements. It may also happen that the food intake is adequate but a person has a problem with digestion, absorption, and utilization in the body.
2. Over-nutrition - is the pathological state resulting from the consumption of an excessive quantity of food over an extended period of time. The risk of over-nutrition is much higher if physical activity is less. It is characterized by being overweight, poor body stature, lack of stamina, and impaired functioning of the body.
3. Imbalance is the pathological state resulting from a disproportion among essential nutrients with or without the absolute deficiency of any nutrient.
4. Specific deficiency is the pathological state resulting from a relative or absolute lack of an individual nutrient.

Inter-relationship between nutrition and health - Food, Health, and Nutrition are interrelated and very important aspects of life. Next to air and water, food is basic to our existence. Nutrition is, "the science of foods, the nutrients and the other substances therein, their action, interaction, and balance in relation to health and disease, the process by which the organism ingests, digests, absorbs, transports and utilizes nutrients and disposes off their end products".

There are close interrelationships between the metabolism of nutrients. The level of intake of one nutrient can influence the requirement of the other. Energy intake must be adequate for the proper utilization of protein. When energy intake is reduced, protein utilization is impaired. Since several B-complex vitamins take part in energy and protein metabolism, their requirements would depend upon the intake of energy and protein. Thus the requirements of B-vitamin, thiamin, riboflavin, and niacin are in fact expressed in relation to energy requirements and that of pyridoxine in relation to protein requirement. The absorption and utilization of iron depend upon an adequate intake of ascorbic acid. There are also metabolic interconversions of nutrients in the body which are considered while establishing their requirements. Well-known examples of such conversions are - the conversion of tryptophan into niacin and of beta-carotene into retinol.

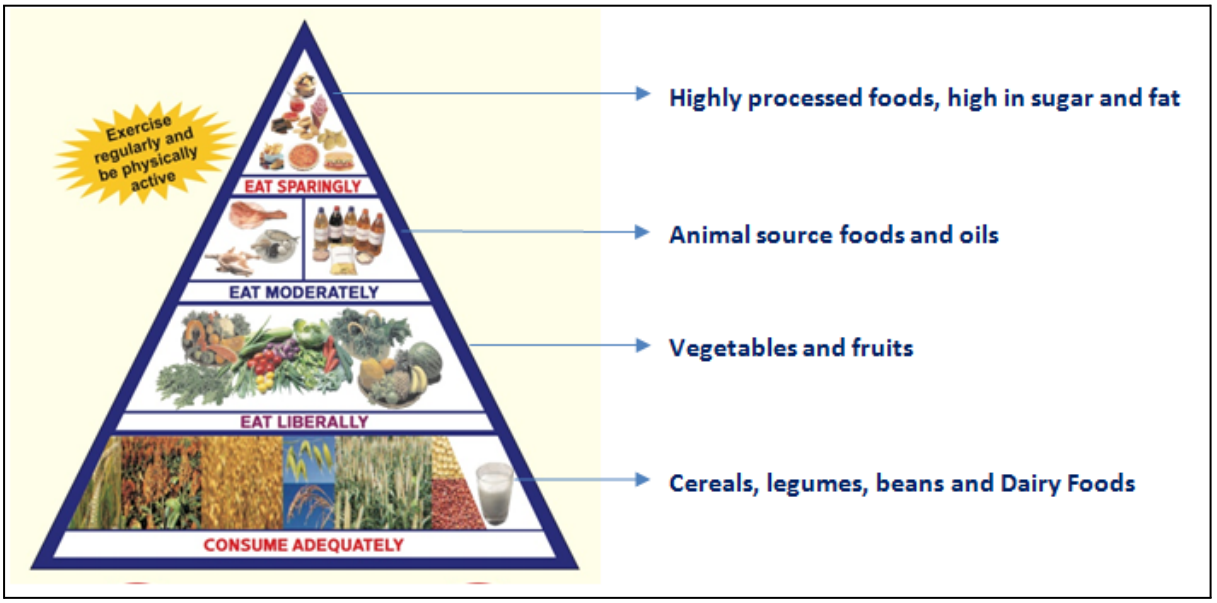
FUNCTIONS OF FOOD -

1. Physiological functions -
   i. Body building - food is required for the growth of new tissues and also to replace worn-out tissues and cells, so as to maintain good health. A newborn baby weighing 2.7-3.2 Kg. at birth doubles birth weight by 4-6 months and triples the same by 1 yr. The baby grows to its potential adult size of 50-60Kg. In adulthood food eaten helps to maintain the structure of the adult body and replaces the worn-out cells.
   ii. To provide energy: the body needs the energy to sustain the involuntary processes. Beating of heart, digestion, voluntary and physical activities, which include professional, household, and recreational activities. In the body, the food ingested or eaten is converted to useable nutrients, which help the body to grow, reproduce and keep it warm. For the conversion of food to nutrients, energy is also required.
   iii. Regulatory functions: of the body include the beating of the heart, maintenance of the body temperature, controlling water balance, and removing waste products.

2. Social functions - food is an integral part of our social existence. Special foods are served at functions, places of worship, birthdays, marriages, and religious festivals. Food is also served at formal gatherings like seminars, and meetings where people come together and share food.

3. Psychological functions: food helps to satisfy emotional needs like love, affection, sense of security. Sharing of food is a token of friendship and acceptance. Certain negative feelings like depression, frustration, anxiety, sadness, and insecurity lead to craving sweets.

FOOD GUIDE PYRAMID -



No. of band	Name of the band	Foods included	Predominant nutrients
1st (Lowest band)	"EAT ADEQUATELY"	Cereals and pulses	Energy, protein, certain vitamins, minerals and fibers
		Pulses and nuts	Essential fatty acids, iron and protein
2nd	"EAT LIBERALLY"	Fruits and vegetables	Fibre, vitamins and minerals
3rd	"EAT MODERATELY"	egg , meat, fish	Proteins, iron, cholesterol, saturated fats, omega 3
4th	"EAT SPARINGLY"	Fats, oils, sugar, sweets, processed foods, ready to eat snacks	Increase risk of diseases

Other signs included are "SAY NO" to alcohol and smoking as they have adverse effects on health.

Emphasis has also been placed on regular exercise and physical activity in order to achieve good health.

DIGESTION, ABSORPTION, AND METABOLISM -

Digestion is the process that prepares food for absorption by the body. It is the process by which large complex indiffusible food particles (CHO protein and fat) are broken down by mechanical and chemical activity into small simple diffusible particles (glucose, amino acids, and fatty acids). These smaller units are then able to cross the semipermeable membrane of the intestinal wall and get absorbed. During this process of digestion, some vitamins and minerals bound to these compounds are released for use by the body.

A. **Mechanical Digestion -** involves physical processes like mastication or chewing, swallowing, churning, or peristalsis. Mastication of food reduces the food particles in size and mixes them with saliva and also gets diluted by water so that it is easy to swallow. It also helps to increase the surface area of food, so that digestive enzymes can have greater contact during peristalsis. After the food is swallowed it is mixed with enzymes and acid by the churning or peristalsis action in the stomach. Further peristalsis i.e. rhythmic contraction of the intestinal wall muscle helps to break the food into still smaller particles which thoroughly mixes food with the digestive juices as it also moves the food mass forward through the digestive tract.
B. **Chemical Digestion -** this takes place through the process of hydrolysis where large molecules are broken down into smaller ones by the addition of water and are catalyzed by enzymes. The food components i.e. CHO, protein, and fat break up into smaller units like monosaccharides or glucose, amino acids, and fatty acids which are then absorbed into the bloodstream.

Enzymes are the organic catalysts that accelerate chemical reactions in the mouth, stomach, and small intestine. Enzymes are proteins in nature and have the following characteristics:

1. Most enzymes are substrate specific i.e. that act only on particular substrates, e.g. sucrase will act on sucrose and give glucose and fructose.
2. They are also PH specific and function only at particular PH.

3. Enzymes get inactivated at high temperatures.
4. Enzymes are named using the suffix 'ase', e.g. enzymes acting on sucrose will be named sucrase and on protein as protease, CHO as amylase, and fat or lipid as lipase.

Water, mucin(polysaccharide), HCl, enzymes, and hormones are all interrelated in the process of digestion. Digestive juices supply an abundance of water at all points of the intestinal tracts.
The role of water is:

- Water holds the food in suspension during movement through the Tract.
- Facilitates peristaltic movement and brings broken-up food particles into intimate contact with the enzymes. Most of the water is constantly reabsorbed from the small intestine and used all over again.

Mucin - the glands of the intestinal tract secrete mucin which is a polysaccharide, which gives a slippery consistency. The walls of the stomach are protected from irritation and erosion by acid because of the coating of mucus. Food moves more readily along the tract because of the lubricating effect of mucin or mucus.

Digestion in the mouth -
The presence of food or anticipation of food brings about the flow of saliva.
This has 2 functions -

1. Saliva mixes with food, lubricating the dry foods and diluting the thicker foods.
2. It provides salivary amylase (ptyalin) which breaks down the complex starch to sweeter and less complex dextrin and maltose.
   When the food is left longer in the mouth, an enzyme, lingual lipase is released from the base of the tongue which can begin lipid digestion.

Chewing helps in 2 ways -

1. Decreases the particle size of the food (1-inch size of the particle is converted into 1/16th of an inch).
2. Food particles have a larger surface area and the enzyme penetration distance decreases.
   Swallowing is the next step. The tongue rolls the food into a small ball or bolus and tosses it at the back of the mouth. From there it is placed on top of the esophagus, when that happens, the epiglottis slips over the trachea thereby preventing food from entering the respiratory tract and lungs.

The esophagus is the tube leading from the mouth to the stomach, the food is passed on by peristalsis, rhythmic contractions that move the food forward through the digestive tract. Food passes from the esophagus into the stomach through the relaxation of the cardiac sphincter. Following the entrance of food into the stomach, the sphincter closes thus preventing the regurgitation of food.

Stomach - the presence of food in the stomach brings about the release of a hormone called Gastrin, which in turn releases HCI from the gastric mucosa, is present and the PH drops to 2.0. mucus is also secreted. The stomach serves as a temporary storehouse of food, brings about partial digestion of protein, and prepares the food for further digestion in the small intestine. The food is gastric continuously churned and mixed with gastric juice until it reaches a liquid consistency called chyme. The action of salivary amylase stops and gastric protease and lipase act.
Gastric juice which is secreted by the stomach contains HCI, pepsin, and renin.
Functions of HCl are:

1. Provides the acidic medium which is necessary for the action of pepsin.
2. It swells the protein and increases the surface area for enzyme action.
3. Calcium and iron salts are most soluble in an acidic medium, therefore they are readily absorbed.

4. Pathogens present in food are destroyed or reduced in the acidity of the stomach.
   Pepsin splits the protein into polypeptides. Enzyme renin helps in the digestion of milk. Very little carbohydrate and fat digestion occur in the stomach because the pH is unfavorable.

Small intestines -

S.I. (20 feet long) is divided into 3 parts i.e. duodenum, jejunum, and ileum. When the food leaves the stomach it is well churned and liquified (chyme), and three sets of secretions complete digestion:

1. Neutralisation by sodium bicarbonate which is released from the pancreas by the action of secretin released from the walls of the intestine. Intestinal enzymes require neutral pH.
2. Bile is released when fat is present, in the gall bladder, which is controlled by the hormone cholecystokinin. Bile helps in the emulsification of fats.
3. Pancreatic enzymes present in the pancreatic juice enter the small intestine. Pancreatic juice contains chymotrypsin and trypsin, which convert proteins into peptones, starch(amylase) into maltose, and fats (lipase) into partial breakdown compounds. The final stages of digestion take place within the cell lining the small intestines. Bile which is manufactured by the liver performs the following functions-
   - To emulsification of fat and increase its fat area to facilitate enzyme action.
   - To neutralize the acidic chyme and provide the alkaline pH necessary for the action of intestinal enzymes.

   Pancreatic protease i.e. Trypsin acts on polypeptides, proteoses, and peptones which are broken down into dipeptides. Lipase acts on fats to produce fatty acids and glycerol, monoglycerides, and diglycerides. Amylase acts on starch to produce maltose and some simple sugars. Lactose is broken down into glucose and galactose, maltose into glucose and glucose, and sucrose into glucose and fructose.

   The digestive process is also aided by friendly microorganisms which live in the intestinal tract. They help in hydrolyzing food and manufacturing some nutrients like vitamin B12, vitamin K, and folic acid.

   Large Intestine - most nutrients i.e. the products of carbohydrates, protein, fat, vitamin, and minerals are absorbed in the small intestines. The remaining food mass contains dietary fiber and water which passes through the ileocecal valve at the end of the S.I. and enters the L.I. Some of this is changed by the digestive action of M.O. and produce gas as a by-product. During the passage of this remaining matter through the L. I. water and some electrolyte are absorbed and ultimately the fecal matter which is semi-solid reaches the anus for defecation.

   Absorption - Various mechanisms are involved in the transfer of nutrients across the membrane of intestinal cells for absorption.

1. **Simple Diffusion or Passive Diffusion:** the movement of molecules from an area of high concentration to a lower one is called simple diffusion. Most of the molecules that move easily across the membrane by diffusion are characterized by their ability to become dissolved in the lipid layer of the membrane. Additionally, substances with low molecular weight such as water and electrolyte also pass by diffusion.
2. **Carrier-Facilitated Passive Diffusion:** water-soluble nutrients cannot penetrate through the lipid-rich cell membrane, therefore they are attached to carriers that facilitate the crossing of the cell membrane. The carriers are believed to be specific protein binding sites in the membrane that combine with the nutrients. In this mechanism the nutrients move from a high concentration to an area of lower concentration and no energy is required.
3. **Active Transport:** here also carrier proteins are required for penetration through the cell membrane but here the movement is from a low area of concentration to a high area of concentration, where energy is required. Energy is supplied by ATP which is got from the metabolism of glucose. Sodium plays an essentially active role in the transport of water, sugar, and amino acids.