1. Details of Module and its structure

Module Detail	
Subject Name	Food, Nutrition for Healthy Living
Course Name	Food, Nutrition for Healthy Living
Module Name/Title	Nutrients in Food - Macronutrients
Module Id	FNHL_10105
Pre-requisites	General knowledge about Nutrients in Food - Macronutrients
Objectives	After going through this lesson, the learners will be able to understand the following : • Different type of macronutrients • Select complex carbohydrates over simple carbohydrates for healthy living • Comprehend healthy sources of fats in our diet • Importance of consuming complete proteins • Importance of keeping oneself hydrated
Keywords	Carbohydrates, Proteins, Fats, Vitamins, Minerals, Water

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1. INTRODUCTION

‘‘You are what you eat” is an old saying and it is quite true! The food that you eat provides you energy to carry out your daily activities. It helps you to repair worn out tissues and also helps in synthesis of new tissues during growth. Food also has protective nutrients and other substances which help in regulating body processes as well as improve our ability to fight disease.. We eat different kinds of food such as dal, chapatti, bread, rice, vegetables, fruits, milk, lassi, etc. Different kinds of food provide different nutrients to keep us healthy and active.

Nutrients are the “chemical components of food that are capable of performing specific functions related to body’s ability to work, grow, develop and maintain good health when supplied in appropriate amounts.” A diverse diet, i.e. a diet which contains a variety of food items from different food groups can provide us many different nutrients which are needed to perform important functions in the body.

Nutrients which are essential for survival and growth of the body include:

- Carbohydrates
- Proteins
- Fats
- Vitamins
- Minerals
- Water

We need a wide range of nutrients to keep ourselves healthy. Most foods contain more than one nutrient such as milk has nearly all the nutrients – water, carbohydrate (lactose), proteins (casein and whey proteins), fats, most vitamins and minerals. Our traditional staple, i.e. chapati provides carbohydrates, some protein and certain vitamins and minerals. Different coloured fruits and vegetables are a powerhouse of nutrients and provide many vitamins and minerals. Nutrients can be broadly classified as **Macronutrients** and **Micronutrients** – based on the amount in which they are required by our body. Both macronutrients and micronutrients are extremely important for our body

as each nutrient has specific roles to play. Carbohydrates, protein, fat and water are considered to be macronutrients, needed by our body in quantities ranging from few grams to kilograms. Vitamins and minerals are the micronutrients needed by the body in milligram or microgram quantities. Besides nutrients there are certain plant chemicals which have important health-protective effects, even though they are not essential for life.

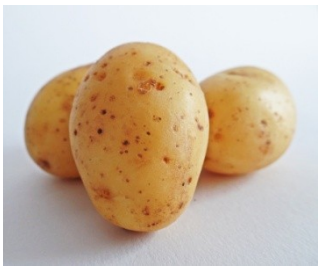
In this chapter, we will learn about the role of macronutrients in our body i.e.. Carbohydrates, fat, protein and water. .

The nutrient needs rise throughout infancy and childhood, peak in adolescence and then level off or even diminish in adulthood (except during pregnancy and lactation).

Sources of carbohydrates


Roti/chapati


Rice


Potato

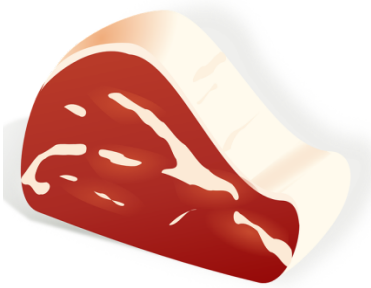

Sweetpotato

Sources of fat


Cooking oil

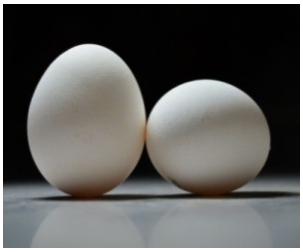

Ghee

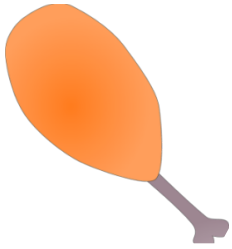

Butter


Fatty meat

Sources of protein


Dal


Eggs


flesh foods (chicken, meat, fish)


milk

Chickpea

Sources of water

Drinking water

Beverages

Foods and dishes rich in water

Sources of vitamins and minerals

Vegetables

Fruits

2. MACRONUTRIENTS

2.1. Carbohydrates

Carbohydrates are organic compounds made of Carbon (C), Hydrogen (H) and Oxygen (O). They constitute the major bulk of our diet constituting 55-65% of the total calorie intake and hence, are the highest contributors to the energy intake of individuals. Cereals & millets provide the highest amount of carbohydrates along with pulses & legumes, , followed by fruits and vegetables and of course simple sugars like table sugar, honey and jaggery.

Types of Carbohydrates

Carbohydrates can be classified as:

a. Monosaccharides or Simple Sugars – these are single units of sugar which cannot be broken down any further upon digestion & are directly absorbed by the body, providing instant energy. For e.g.
Glucose, Fructose and Galactose

b. Disaccharides or Double Sugar – these are made of two sugar units attached to each other. For e.g.
   - Sucrose (Table Sugar) is made of – Glucose + Fructose
   - Maltose is made of – Glucose + Glucose
   - Lactose (milk sugar) is made of– Glucose + Galactose

c. Oligosaccharides – these are made of 3-9 sugar units. For e.g. raffinose, stachyose, etc. found in pulses and legumes.

d. Polysaccharides or Long Chain Sugars – they have more than 10 single units bonded with each other. Polysaccharides are of two types:
   - Starch polysaccharides –starch found in plants e.g. cereals and pulses; glycogen found in animal tissues like muscle and liver
   - Non-starch polysaccharides – are referred to as Dietary Fibre These are of two types – soluble and insoluble fibre. Insoluble fibres include cellulose, hemicellulose, lignin, found in bran layer of whole grains, seed coat of pulses and legumes, stalks/seeds of vegetables and fruits. Soluble fibres include pectins, gums and mucilages found in fruits, vegetables, oats, etc.

d.

Functions of Carbohydrates

1. The most important function of carbohydrates is to provide energy. One gram of carbohydrate provides 4kcal.
   - Glucose is the main source of energy for the central nervous system.
   - Glucose provides energy to the heart muscle.
   - The main source of energy for muscular work are carbohydrates.

2. Protein sparing action is an important function of carbohydrates. When an individual does not consume adequate amounts of carbohydrates, the body utilises protein for fulfilling it's energy requirements. A minimum of 100 g of carbohydrate is essential.
3. Carbohydrates are essential for the normal oxidation of fats. Adequate carbohydrates in the diet prevent Ketosis i.e. accumulation of intermediate ketone bodies in the blood.
4. Carbohydrates like fibre give bulk to the diet and thus provide satiety value., i.e. they make us feel full.
5. Gastro-intestinal microbial flora digests the fibre resulting in the production of short-chain fatty acids which can be used as a source of energy and are beneficial for the health of the intestinal mucosal cells..
6. Liver rich in glycogen is resistant to toxins. Glycogen has a detoxifying action & hence protects the liver from certain poisons.

Food Sources of Carbohydrates

Simple Carbohydrates - Monosaccharides & Disaccharides

Type of Carbohydrate	**Food Sources**
Glucose	Fruits, vegetables, honey
Fructose	Fruits, vegetables, honey, high fructose corn syrup
Galactose	End product of lactose digestion in the body
Lactose	Milk & milk products
Sucrose	Sugarcane, table sugar, beetroot
Maltose	Germinated/sprouted seeds, grams & barley

Some sources of simple carbohydrates
(From top left – fruits, vegetables, milk, cottage cheese, curd, sprouts, beets)

Complex Carbohydrates

Type of Carbohydrate	**Food Sources**
Starch	Roots & tubers, cereal grains, pulses, beans – millets & legumes
Glycogen	Liver, muscle tissues
Soluble Fibre	Pectin - fruit pulp, mucilages - legumes & –β glucan - oats
Insoluble Fibre	Peels & seeds of fruits & vegetables, stalks, green leafy vegetables, seeds, bran, beans, whole grain cereals

As we can see, the main food sources of carbohydrates in our daily diet are whole grain cereals and pulses, fruits and vegetables, milk and its products and sugar in various forms.

Dietary Fibre

It is the portion of food derived from plant cells which is resistant to digestion in the human small intestine, but which may undergo partial/complete fermentation in the large intestine. It consists of cellulose, hemicellulose, lignins, gums & waxes, pectins, oligosaccharides & other plant substances.

Types of Dietary Fibre

It is of two types:-

- Soluble Fibre – It dissolves in water e.g. mucilages, gums & pectins
- Insoluble Fibre – It does not dissolve in water e.g. hemicellulose, cellulose & lignin

Functions of Dietary Fibre

1. It helps in the regulation of bowel movements, thus, protecting the body from Constipation, Haemorrhoids, Diverticulitis & Colorectal Cancer.
2. It aids in reducing blood glucose & triglyceride levels by reducing their absorption. It helps in the prevention & control of diabetes (TYPE 2) & cardiovascular diseases by keeping the sugar and lipid levels in blood under control.
3. Some dietary fibre helps in the growth of good bacteria in our stomach.
4. Fibre upon fermentation in the large intestine by bacteria produces short chain fatty acids which can provide energy & are good for the intestinal mucosa.
5. It helps to lose & maintain weight as it slows the passage of food through the stomach thus providing satiety (i.e. feeling of fullness) for a longer period of time.

Food Sources of Dietary Fibre

Type oF Fibre	**Food Sources**
Soluble Fibre	Fruit pulp, fleshy part of vegetables, legumes & oats e.g. banana, apple, guava
Insoluble Fibre	Peels & seeds of fruits & vegetables, stalks of green leafy vegetables, seed coat of legumes & beans , bran of cereals





Oats **Wheat bran** **Pulses** **Greenleafy vegetables** **Legumes**

Recommended Intake of Carbohydrates

It is usually recommended that 50-60% of calories in the diet should be contributed by carbohydrates, with not more than 10% energy coming from simple carbohydrates

The type of carbohydrate included in the diet is more important than the quantity of carbohydrate. One should try to consume less amounts of simple carbohydrates (refined cereals like maida, sugar & products made of sugar like sweets, desserts, ice creams, candies, soft drinks, jams & jellies) and include more of complex carbohydrates (fruits, vegetables, legumes, whole grain cereals). Dietary fibre recommended for a normal adult is 40 g/day. Half of the recommended amount should be contributed by the cereals & the other half by vegetables & fruits.

Health Significance of Carbohydrates

Not consuming sufficient amounts of carbohydrate may lead to the body using fat and protein as alternate energy sources. Excessive production of ketone bodies may lead to the condition of ketosis. Protein should be used by the body for tissue building rather than energy production.

Maintaining energy balance is the major concern. Consumption of excessive amounts of carbohydrates which are not utilised to provide energy, result in their storage in the body as fat. Weight gain can lead to obesity and its associated consequences like cardiovascular diseases, diabetes, cancer, etc.

Dental Caries are associated with excessive consumption of sugary foods Bacteria in our mouth act on the sugar, especially that which is still stuck to the teeth, releasing acids which dissolve the enamel and make it prone to cavities.

2.2. Fats

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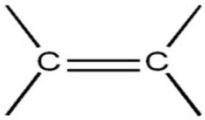
Lipids are a heterogenous group of substances including fats, oils and fat-like substances that are greasy in texture, and soluble in organic solvents. Lipids are concentrated sources of energy in our diet. They are the second largest contributors to energy intake, providing 20 - 30% of the total energy intake. Lipids in our diet are mostly fats (or triglycerides), followed by phospholipids and cholesterol esters. Fats are highly complex compounds composed of carbon, hydrogen & oxygen. They are present in nearly all the foods that we eat, adding a special taste & flavor to the food. Each gram of fat provides 9 kcal. Fatty Acids are the main constituents of all lipids.

Types of Fatty Acids

Fatty acids can be classified in various ways as follows:

1. ***Based on the degree of saturation***

As we have mentioned earlier that fatty acids are the main constituent of fats. Saturation here means that whether the fatty acids contain carbon –carbon double or triple bonds.

The fatty acids are classified into two types of fatty acids  based on saturation.

- *Saturated fatty acids* – have no double or triple bonds between the carbon atoms. Oils and fats with saturated fatty acids are solid at room temperature e.g. Ghee, butter, palm kernel oil, coconut oil.
- *Unsaturated fatty acids* – have one or more double bonds between the carbon atoms.
  - *Monounsaturated fatty acids (MUFA)* – have a *single double bond* in between the carbon atoms e.g. Oleic Acid present in palmolein, groundnut oil, olive oil, sesame oil, cottonseed oil, red palm oil, mustard oil etc.
  - *Polyunsaturated fatty acids (PUFA)* – have *two or more double bonds* between the carbon atoms. Sunflower oil, corn oil & safflower oil are rich sources of PUFA.

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Trans fatty acid - An unhealthy isomer, made during the process of hydrogenation of oils. Vanaspati is an example of hydrogenated fat. The naturally occurring isomer of unsaturated fatty acids is the *cis* form.

2. ***Based on chain length***

Based on the length of the carbon chain, fatty acids can be classified as short, medium and long chain fatty acids.

- *Short chain fatty acids* are usually less than 6 carbon atoms in length. Examples include butyric acid found in milk fat, ghee and butter. These are rapidly digested and can be directly absorbed from the intestines into the blood circulation.
- *Medium chain fatty acids* contain between 6 and 10 carbon atoms. Examples include caproic, caprylic and capric acids present in milk fat and also coconut oil and palm kernel oil, which is considered to be a rich source of medium chain fats. These are also rapidly digested and directly absorbed from the intestines into the blood circulation.
- *Long chain fatty acids* have 12 or more carbon atoms. These include lauric, myristic, palmitic, stearic, oleic, linoleic and linolenic acids. These are found in all the vegetable oils we use for cooking. Most fatty acids present in animal tissues contain 16-26 carbon atoms.

3. ***Based on Nutritional properties***
    - *Essential fatty acids* – are the ones which are very important for growth & development but cannot be synthesized by the body. Linoleic (omega 6) and linolenic acid (omega 3) are the two essential fatty acids. Thus, they must be supplied by the diet. Rich food sources of essential fatty acids are- soyabean, safflower, sunflower,cotton seed oil, and other cooking oils, oily fish like cod, salmon, cereals and legumes, nuts, etc.
    - *Non – essential fatty acids* – are the ones which can be synthesised in the body & are not required from the diet. Stearic, palmitic & oleic acids are the non-essential fatty acids.
    - Fats in our diet can also be classified on the basis of their visibility as: *Invisible fats* – fats which are a part of foods and hence not visible to the eye for instancethe fat present in fish, milk & milk products, meat, egg, nuts & oilseeds.
    - *Visible fats* – are the added to food during preparation & processing. These are fats that can be seen. e.g. oils, ghee, butter, vanaspati & cream.

Functions of Fats

1. Dietary fat has a very important role to play in our bodies. Fats are the chief source of energy for the body. Excess fat is stored inside the body (in the abdomen, surrounding the organs & laced throughout the muscle tissue) as a reserve of energy to be used in times of need.
2. Fats are concentrated sources of energy. One gram fat provides 9kcal; twice the amount as compared to carbohydrates & proteins. Adding some fat to food increases its energy density, thereby reducing the bulk of the diet. This is especially important for small children who cannot have a large quantity of food at a meal. Example adding some ghee to the dal or kheer served to the small child, willmake it energy dense.
3. Fat is an integral part of the structure of the human body; all body cells contain fat in their cell membranes. Amongst healthy & non-obese men & women; 15-25% of the total body weight is fat.
4. Essential fatty acids and long chain PUFA synthesized from these like EPA, DHA and Arachidonic acid perform vital functions in the body. They lead to formation of other substances in the body which are needed for the regulation of a number of vital functions like blood pressure, blood clotting, immune responses, inflammatory responses and regulation of body temperature, etc. DHA is important for normal development & maturation of the retina of the eye & brain development during the first 1000 days.
5. The stored fat acts like an insulator preventing the body from losing heat easily, thus helping to regulate body temperature.

6. Adipose tissue provides a protective cushioning/ padding around the delicate internal organs of the body such as liver, heart & kidneys.
7. It keeps the gastrointestinal tract lubricated helping in smooth movement of food.
8. Fat provide higher satiety value to the meals as it reduces gastric motility, meaning that the movement of the ingested food out of the stomach slows down thereby giving a feeling of fullness for a longer time.
9. Dietary Fat is required for the absorption of fat soluble vitamins – A, D, E and K. A zero fat diet is considered unhealthy.
10. Fat provides variety & flavour to the food thereby increasing the palatability of the food.

Food Sources of Fats

Type of Fats or Fatty Acids		**Food Sources**
Saturated Fatty Acid		Ghee, butter, milk fat, cream, palm kernel oil, vanaspati, coconut oil, fat in meat, egg yolk, margarine, lard, bakery fat
Unsaturated Fatty Acid	Mono Unsaturated Fatty Acids	Palmolein, red palm oil, groundnut oil, olive oil, sesame oil, cottonseed oil & ricebran oil
	Poly Unsaturated Fatty Acids	Corn oil, fish oil, sunflower oil & safflower alongwith other vegetable oils but not coconut oil.
Essential Fatty acids		Soyabean, mustard oil, sesame oil, olive oil, groundnut oil, rice bran oil & safflower oil
Cholesterol		Organ meat like liver, kidney & brain, egg yolk, milk fat, prawn, shrimp & red meat

Some food sources of fats

(From top left – butter, ghee, cheese, coconut, cream, beans, pulses, green leafy vegetables, cereals, meat, egg. Some of these are not very high in fat content but are good sources of essential fatty acids in the diet)

Health Significance of Fats

Consuming the right combination of fats & oils in appropriate quantities is important. Ideally calories from fat should be between 20-30% of the total calories, with less than 10% calories coming from saturated fats. Eating too little fat can result in poor absorption of fat soluble vitamins (Vitamins A, D, E & K) as well as overdependence on carbohydrates to provide the energy resulting in a very bulky diet. Unsaturated fatty acids like PUFA and MUFA help to decrease the risk of heart diseases by lowering total cholesterol and LDL (Bad) cholesterol levels. Omega 3 fatty acids prevent inflammation and accumulation of fatty material in blood vessels thus protecting against heart diseases. They also prevent thrombosis or clotting of blood thus reducing the risk of strokes.

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On the other hand, excessive intake of fat can lead to weight gain & obesity. There is increased risk of cardiovascular diseases and certain types of cancers. Excessive consumption of saturated fatsraises the total and LDL cholesterol levels. They have also been shown to contribute to

insulin resistance. Hence, they increase the risk of heart disease and diabetes. Trans fats also increase the risk of heart disease by increasing LDL cholesterol, decreasing HDL (Good) cholesterol, increasing inflammation and insulin resistance in the body.

2.3. Proteins

The word ***'Protein'*** is derived from the Greek word ***'protos'*** which means 'to **take first place**'. These are organic compounds composed of carbon, hydrogen & oxygen along with nitrogen. Nitrogen gives proteins their characteristic properties. Proteins are basic building blocks of our body which are essential for growth, maintenance & repair.

Proteins are composed of amino acids connected to one another by peptide linkages to form chains. Some amino acids consist of sulphur atoms while some others contain phosphorus atoms. Half the protein present in the body is present in muscles, 20% in bones, 10% in the skin & the remaining is present in other parts of the body.

According to recommendations, proteins should contribute between –10-15% of the total calories in our diet. Extra consumption of protein does not provide any special health benefit as it is not used for tissue synthesis. It is instead oxidised and the load on the kidney to excrete the breakdown products like urea and uric acid increases.

Types of Amino Acids

- *Essential Amino Acids* – are the ones that cannot be synthesised by the body to meet the requirements of growth & maintenance. There are 9 essential amino acids.
- *Non-Essential Amino Acids* – are the ones that can be made by the body in sufficient amount to perform the various functions. There are 11 non - essential amino acids.

Essential Amino Acids	**Non-Essential Amino Acids**
Histidine	Alanine
Isoleucine	Arginine
Leucine	Asparagine
Lysine	Aspartic Acid
Methionine	Cysteine
Phenylalanine	Glutamic Acid
Threonine	Glutamine
Tryptophan	Glycine
Valine	Proline
	Serine
	Tyrosine

Types of Proteins

1. ***Classification based on Nutritional Properties***

- *Complete Proteins*– these contain all the essential amino acids (9) in appropriate amounts to promote growth & maintenance of the body normally. These proteins support tissue formation better. They are available through eggs, poultry, meat, fish, and milk.
- *Partially Complete Proteins* – these proteins are deficient in certain amino acids and hence can support maintenance & repair of body tissues, but not growth. They are generally present in cereals & pulses.
- *Incomplete Proteins* – these proteins are lacking certain amino acids. They can neither support growth nor be used for maintenance & repair e.g. Gelatin from collagen of animals & Zein from corn.

Functions of Proteins

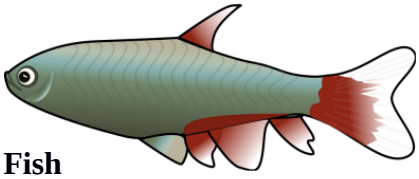
Proteins perform diverse functions in the body. The efficiency with which the work is done by the proteins depends upon their quality in the diet:

1. Protein in its several forms helps in the formation of tissues for growth & maintenance of the body. The structural components of our body are composed of proteins e.g. muscles, bones, enzymes, blood, skin, hair etc.
2. Proteins perform specific regulatory functions in the body in the form of enzymes for metabolicreactions or as hormones to regulate processes.
3. Proteins if required can provide energy to the body in the absence of carbohydrates & fats. One gram of protein when digested provides 4 kcal, equal to that of carbohydrates. However, proteins cannot be substituted for carbohydrates for provision of energy, as unlike carbohydrates they are not completely oxidized and their breakdown products need to be excreted by the kidneys.
4. Proteins strengthen the body's immunity & enhance the ability to fight infections.
5. DNA & RNA which carry the blueprint for the synthesis of all other body proteins are also proteins in nature.
6. The pH of the body is maintained by the regulation of acid-base balance which is an important function of proteins.
7. Proteins help to regulate the osmotic pressure of the body & maintain proper fluid balance between blood & it's surrounding tissues.
8. Proteins bind with various compounds & aid their transport to their site of action e.g. haemoglobin transports oxygen from lungs to all cells, tissues & organs through the medium of blood.
9. Movement of the bodyby contraction & relaxation of muscles is regulated by actin & myosin which are proteins.
10. Some specific proteins in the form of amino acids also perform highly specialised functions e.g. formation of niacin from tryptophan (an essential amino acid).

Food Sources of Proteins

Proteins are available in nature from both plant as well as animal sources. Proteins consumed from animal sources are better in quality as they contain all essential amino acids thus, promoting growth, maintenance & repair. Vegetarians can obtain good quality protein from consuming milk and milk products and from combining cereals and pulses in meals. This combination helps to make up for the amino acids which are deficient in either cereals or pulses and is called mutual supplementation. Cereals are deficient in amino acid lysine, but pulses have sufficient quantities of it. Pulses on the other hand are deficient in methionine. Cereals have enough of methionine and hence make up for the deficiency when the two are eaten together as in traditional combinations of *dal-roti or dal-chawal.*

Animal Sources	**Vegetable Sources**	
Egg	Soyabean	Almonds
Meat	Green Peas	Walnuts
Fish	Pulses	Pistachio nut
Mutton	Cow peas	Groundnut
Poultry	French beans	
Milk	Chick peas	
Yoghurt	Kidney beans	
Cottage cheese	Bengal Gram	
Processed cheese	Whole wheat	
Curd	Millets	
Khoya	Rice	



Fish

Paneer

Peanuts

Peas

Curd

Beans

Almonds

Sources of Protein

Health Significance of Proteins

Consuming sufficient protein from good food sources is essential for good health. Proteins from different food sources through a balanced diet is essential. Deficiency or excess can both be harmful.

Protein deficiency can occur during any life stage but, it is most detrimental in case of infant's as well young children as these are years of growth. Symptoms of protein deficiency are manifested as growth retardation. Protein-energy malnutrition (PEM) amongst children can lead to:

- *Underweight* – low weight for age
- *Stunting* – low height for age
- *Wasting* – low weight for height

Children under 5 years of age may suffer from kwashiorkor or marasmus, the two forms of PEM.During pregnancy & lactation, consumption of adequate good quality protein is essential for growth of the foetus, enlargement of maternal tissues, increase in blood volume & later secretion of sufficient milk.

Protein is also required for speedy & complete recovery after surgeries & disease episodes.

Excess of dietary protein may lead to impairment of kidney function as the load on the kidneys to filter waste increases manifold. Too much protein in the diet (especially animal protein) can increase mineral losses especially of Calcium from the bone mass thereby, increasing the risk of osteoporosis. If the protein is derived from an animal source there are greater chances of consuming moresaturated fat & cholesterol, which increases the risk of heart disease. Some studies have associated the consumption of higher animal protein to certain types of cancer.Diets high in meat & seafood tremendously increase the risk of Gout – a condition of painful inflammatory arthritis.

2.4. Water

". Water is perhaps the most important nutrient as it makes up for nearly 55-70% of our body weight depending upon our body composition & age. Nearly 75% of the active muscle mass is composed of water & about 25% of the fat mass is composed of water. It can be considered as the most important nutrient for our survival as without food we may last several days but without water we can't survive.

Functions of Water

1. Water is the solvent for numerous substances in our body like glucose, minerals, vitamins, amino acids etc.
2. Water is essential for the maintenance of normal body temperature. Blood which has water as its major component distributes the heat generated during metabolism from a specific organ to the entire body. Water in the form of sweat evaporates from the skin & cools the body during summers.
3. Water maintains appropriate blood volume as it is the major constituent of blood plasma.
4. Water provides lubrication to various organs such as joints thereby easing the movement of the joints & reducing the wear & tear of cartilage & bones. It assists the metabolic processes of the body like presence of saliva in the mouth which helps to chew food & pass it down the oesophagus for further digestion.
5. Water is required for the transportation of solutes & nutrients in the body.
6. Water helps the body to absorb water soluble nutrients. It is also a source of dietary minerals like calcium, magnesium, zinc, copper and fluoride.

Sources of Water

- Safe drinking water
- Soups & broths
- Fruit & vegetable juices
- Coconut water
- Milk
- Lassi or chhach
- Nimbu pani & sherbets
- Aerated beverages
- Tea & coffee

Milk, Lassi & chhach are healthier in comparison to soft drinks as they provide protein, calcium & some other important nutrients.

The best beverage to quench thirst is always potable water.

Sweetened beverages are a source of empty calories. Tea & coffee should also be consumed in moderation as excessive consumption can cause be dehydration.

Water in its bound form is present in fruits & vegetables. Citrus & juicy fruits have the highest water content e.g. sweet lime, oranges, muskmelon, watermelon, grapes etc. Amongst the vegetables, green leafy vegetables have the greatest amount of water alongside ridge gourd (tori), bottle gourd (ghia), tinda, striped pear gourd (parwal), cucumber, pumpkin, tomato, brinjal etc.

Health Significance of Water

The requirement of water for a person depends on the body size, environmental conditions & his/her physical activity. The human body excretes water through urine, sweat & faeces. This loss needs to be replenished on a daily basis for which we should consume 2 – 3 litres (8 – 12 glasses) of fluids daily. This is a sum total of the consumption of water through plain water, drinks, beverages & food.

Dehydration is the condition which results from imbalance between intake & output of the body. Lack of optimum quantity of water in the body due to disease or illness (like vomiting & diarrhoea) can lead to dehydration . Dehydration if not treated promptly can be fatal. It needs immediate attention in case of infants, children & elderly adults.

Water must be provided in adequate amounts to perform all body functions.

But, on the other hand consuming too much water can lead to water toxicity/ water intoxication. Blood becomes too dilute in presence of excessive water which disturbs the concentration of many substances dissolved in it thereby, affecting many functions & metabolic processes. Blood sodium levels are the most severely affected & this can lead to a life threatening situation. Water moves out of the blood vessels into tissues because of blood dilution, leading to oedema. Accumulation of water in the brain cells can lead to convulsions, headache, blurred vision & muscular cramps. It is not advisable to consume more than 1 – 1.5 L of water per hour even after heavy sweating.