Anatomy and physiology: need for nutrition

Nutrition is the process by which living organisms obtain or absorb food. These foods contain chemical substances which are the source of energy and necessary for growth, repair and maintenance. Nutrients build the body and allow it to function.

There are six types of nutrients; carbohydrates, protein, fats, vitamins, minerals and water which living organism need for sustenance.

Carbohydrates produce and store energy and heat. There are two types of carbohydrates; simple and complex. Examples of simple carbohydrates are glucose and sugars. Complex carbohydrates are the starches the body gets energy from, they include; potatoes, rice and pasta.

Protein plays a vital role in the formation of structures in organisms. They are used for body building or growth and repair of damaged tissue. Proteins are also used in the formation of enzymes, hormones and muscle.

Living organism also needs fat to be healthy because it supplies and stores energy and heat. They are used in the transportation of the fat soluble vitamins and supports organs like the kidneys, and signals hormones.

Vitamin A ensures proper bone growth and healthy skin, vitamin B complex breaks down carbohydrates and fat and helps to give healthy nervous system, whiles vitamin C heals wounds and helps the immune system. Vitamin D ensures the absorption of calcium for strong bones and teeth whiles vitamin E helps in the formation of red blood cells.

Minerals also play important function in the body: Iron is very important in the formation of haemoglobin, Calcium and phosphorous are needed for the formation of strong bones and teeth, whiles Iodine is important for the proper functioning of the thyroid gland.

Water is an important compound because it provides the medium in which all biochemical reactions such as digestion, excretion and absorption takes place. Water helps in regulating the body temperature and also forms the basics of all the body fluids.

2. 1 Explain the functions of carbohydrates, lipids and proteins, and evaluate different food sources.

Carbohydrate is one of the nutrients that provide our bodies with energy. They include sugars and starch, and their principal function in organisms is the production and storage of energy and heat. There are two types of carbohydrates; simple and complex. Examples of simple carbohydrates are glucose and sugars, whiles complex carbohydrates are the starches the body gets energy from. Different food sources of carbohydrates are; rice, potatoes, and pasta. If the right amount is taken, they supply the body with the required energy needed for the muscle, brain and central nervous system. They also play an important role in the metabolism of amino and fatty acids as well as regulating blood glucose.

Lipids consist of natural fats and oils which are derived from plant and animal sources.

They perform the function of storing and supplying of energy, body building components and certain vitamins. Most of the energy used by the heart is obtained from fats. Lipids also protect various organs. Lipids are also used as hormones that play the role in regulating body metabolism. They help in the production of hormones and store vitamins – ADEK. Sources of fats are: margarine, milk and groundnut oils.

Proteins play a vital role in the formation of structures in organisms. Proteins are built up from amino acids and are used for body building or growth. They are also for the repair of damaged and worn out tissues. When there is shortage of carbohydrates and fats, they are used for the production of energy. Proteins are also used in the formation of enzymes, hormones and muscle. They also form a major component in the bone, muscle and other tissues and fluids. Food sources of protein include; meat, fish, eggs and groundnut and the end product of digesting protein is amino acids.

2. 2 Explain the need for vitamins and minerals and evaluate different food sources.

Vitamins are organic constituents of food required in very small amounts for a variety of metabolic purposes and for good health. Minerals on the other hand are inorganic elements essential for normal growth and development. There is the need for vitamins and minerals because they are important for maintaining good health and prevents some diseases. They are found in a variety of foods, so a balanced diet should provide the body with the needed quantities. They control the chemical reactions within the body to convert food into energy. There are 13 vitamins which are classified into two groups: water soluble vitamins which are B & C and fat soluble vitamins; A, D, E & k.

Vitamin A is important for growth and healthy skin, and also helps in the body’s immune system. Food sources for these vitamins include; milk, butter, chicken, and mackerel. Vitamin B complex breaks down carbohydrates and fat and helps to give healthy nervous system; whiles vitamin C heals wounds and helps the immune system. Vitamin D ensures the absorption of calcium for strong bones and teeth and vitamin E helps in the formation of red blood cells. Vitamin K helps the liver in the production of blood clotting factor for the prevention of internal bleeding. Through the activity of the healthy bacteria, the body also makes vitamin K in the large intestine. Various food sources of vitamins include; liver, beans, green vegetables, oranges and egg yolk.

Minerals also play specific and important function in the body. There are two types namely; macro minerals and micro or trace minerals. Macro minerals are needed in large quantities and they are calcium, phosphorous, magnesium, sodium, potassium, chloride and sulphur. Trace or micro minerals are needed in small quantities. Even though the body needs it, it requires just a little bit for the body to function; ion, manganese, copper, iodine, zinc, cobalt, fluoride and selenium.

Ion is present in foods as green vegetables, eggs and kidneys and is very important in the formation of haemoglobin. Its absence reduces the oxygen carrying capacity of the blood and causes anaemia. Calcium and phosphorous are needed for the formation of strong bones and teeth. You can get them from milk, fish and whole grain cereals. Calcium plays a role in blood clotting and muscle contraction. Iodine is important for the proper functioning of the thyroid gland. Its food source include cheese and sea fish. Magnesium is derived from fruits and helps in the transmission of nerve impulses. Potassium is another form of mineral which keeps the muscles and the nervous system working properly. It ensures the right amount of water in the blood and body tissue. Food sources are bananas, broccoli and tomatoes. Zinc is the last mineral type which helps the immune system. It is the body's system for fighting off illnesses and infections. It also helps with cell growth and helps heal wounds such as cuts. The food sources for this mineral include pork, lamp, beans and lentils.

3. 1 Describe the main organs of the digestive system

The digestive system comprises of the digestive tract; a series of hollow organs joined in a long tube from the mouth to the anus, and other organs that helps the body to break down and absorb food, known as the accessory organs. Those accessory organs include the salivary glands, the pancreas, the liver and the gallbladder. The human digestive tract takes in food in various forms and extracts the nutrients that the body turns into energy, and the remains are then excreted.

The digestive tract also contains a layer of smooth muscle that helps to break down food and move it along the tract. Organs that make up the digestive tract are the mouth, oesophagus, stomach, small intestine, large intestine also known as the colon, rectum and the anus.

The mouth is the site of ingestion. Its primary function is to help digest food by crushing and breaking down the size of the food into smaller units. The mouth includes the teeth, tongue and the hard and soft Pilates. There are also three sets of salivary glands: parotid, sublingual and sub maxillary that secrete saliva to help in chewing food. There is a lining in the mouth called the mucosa which contains tiny glands that produces juice to help digestion. The tongue also mixes saliva with food and moves it towards the pharynx.

The oesophagus is a food tube that begins at the pharynx and leads to the diaphragm into the stomach. Bolus is pushed down the oesophagus by peristalsis; a circular sphincter muscle opens to let food pass and closes behind it to prevent the food flowing back from the stomach.

The stomach is the location for breaking down food by gastric acid and digestive enzymes after it comes down the oesophagus. There is also a lining called the mucosa which contains tiny glands that produces juice to help digestion. The small intestine is the main place for digestion because, it where vitamins and nutrients are absorbed. It then passes through the large intestine which compact the waste and stores any water left over from the small intestine. Wastes are finally disposed off by the anus at the end of digestion. The liver, pancreas and gall bladder are important in secreting and storing substances that helps in the breaking down of food.

The liver and pancreas produces digestive juice that reaches the intestine through the small tubes called ducts. Digestive juices are stored in the gallbladder until they are needed in the intestine. Parts of the nervous and circulatory systems also play a major role in the digestive system.

3. 2 Explain the function of the main organs of the digestive system.

The role of the digestive system is the physical and chemical breakdown of food. After ingestion, food and fluids are processed by the digestive organs so that nutrients can be absorbed and circulated through the bloodstream and then to the body for the needed nutrients. Any remaining food which is not able to digest is eliminated through the anus as faeces.

The digestive system is made up of the digestive tract; a series of hollow organs joined in a long tube from the mouth to the anus and other organs that help the body to break down and absorb food.

Organs that make up the digestive tract are the mouth, pharynx, oesophagus, stomach, small intestine, large intestine also known as the colon, rectum, and anus. These are the main organs of the digestive system. There is a lining called mucosa inside these hollow organs. In the mouth, stomach, and small intestine, the mucosa contains tiny glands that produce juice to help digest food. The digestive tract also contains a layer of smooth muscle that helps break down food and move it along the tract.

Mouth is where digestion process begins; food is entered, cut, crushed and chewed by the teeth and broken down with saliva. The process of mechanical and chemical digestion begins at the associated accessory organs such as the teeth tongue and salivary glands through mastication, whiles the mouth also begins the propulsive process of swallowing.

The next organ is the pharynx which serves as the passage way when food is swallowed and connects the mouth and the oesophagus.

The oesophagus is a thick walled muscular tube that connects pharynx with the stomach and serves as the passageway for food from the mouth to the stomach. This works by a process called peristalsis.

The stomach is a j shaped muscular bag which chums, digests, and stores food. It continues the process that began in the mouth of reducing the size of the food. It acts as a temporary storage site for food where chemical digestion of proteins begins. A few fat soluble substances are also absorbed through the lining of the stomach into the blood stream.

Another organ of the digestive system is the small intestine which is located between the stomach and the large intestine. It measures about 6m approximately. The small intestine is where digestion is completed and virtually all the absorption of the digestion products into the blood stream happens. Mechanical digestion and propulsion of the food through the gastrointestinal tract is achieved by the alternate contraction of the smooth muscles of the small intestine wall. Enzymes conveyed through ducts from the pancreas, liver and gallbladder, together with enzymes secreted from the cells lining. The small intestine’s function is to chemically digest the food. The soluble digestion products are taken up into the blood stream by passive and active mechanisms.

The large intestine, also known as the colon is part of the main organs of the digestive system which measures about 1. 8m long approximately and is located by the pancreas and wraps around the small intestines. It is considered as the largest part of the digestive system which contains large amount of vitamin producing bacteria – B1, B2, B6, B12, folic acid and biotin. The large intestine is the site of absorption for the remaining water from the indigestible food matter, stores this unusable food and eliminates them from the body as faeces which consist of indigestible materials, bacterial and sloughed off intestinal cells. The large intestine takes about 11 to 16 hours to finish up the remaining process of the digestive system.

The rectum acts as a temporary storage facility for the human waste. It walls expands the receptors from the nervous system found in the rectum walls, stimulate the desire to remove waste matter from the body through the anus, which is the opening part of the rectum where waste from the body are expelled.

Two solid digestive organs, the liver and the pancreas, produces digestive juice that reach the intestine through small tubes called ducts. The gallbladder stores the liver's digestive juices until they are needed in the intestine. Parts of the nervous and circulatory systems also play major roles in the digestive system.

4. 1 Explain the process of digestion

The digestive system is a gastrointestinal tract that has mouth, pharynx, oesophagus, stomach, small intestine and large intestine. It has other accessory structures, such as salivary gland, pancreas, liver, and gallbladder. (Anatomy and physiology, 1999).

Digestion actually starts in the mouth when food is ingested; food is chewed and mixed with saliva to moisten it, as the enzymes in saliva begin to break down carbohydrate (starch). When food is chewed, it becomes lubricated, warmer, and easier to swallow and digest. The teeth and mouth works together to convert each bite of food into a bolus that can readily move into the oesophagus. There is a lining in the mouth known as mucosa which contains tiny glands that produce juices to help digest food. After the bolus is swallowed, it enters the oesophagus where it continues to be warmed and lubricated as it moves toward the stomach.

The acidic environment of the stomach and the action of gastric enzymes and pepsin convert the bolus into chime, a liquefied mass that is squirted from the stomach into the small intestine. Inside the hollow organs is a lining called the mucosa in the stomach, which contains tiny glands that produce juices to help digest food. Carbohydrates tend to leave the stomach rapidly and enter the small intestine, proteins leave the stomach less rapidly, and fats stayed there the longest. The stomach then secretes juice that works to convert food into a thick liquid. These liquid then passes into the small intestine.

The conversion of protein into amino acids, fat into fatty acids and starch or carbohydrate into simple sugars is what happens next in the small intestines. The small intestine is the principal site of digestion and absorption. Enzymes and secretions from the pancreas, liver, gallbladder, and the small intestine itself, combine to break down nutrients so that they can be absorbed. The pancreas is a veritable enzyme factory, supplying enzymes to digest proteins, fats, and carbohydrates. Intestinal cells also supply some enzymes. The wall of the small intestine has millions of tiny cells that are known as villi. Inside the hollow organs is a lining called the mucosa in the small intestine which contains tiny glands that produce juices to help digest food. Cell has many small blood vessels where digested materials are taking in, and transported to the body cell. Materials that are not absorbed move into the larger intestine, where the water and salt get absorbed. The hard solid waste goes out via anus.

5. 1 Describe the structure of the liver

The liver is the largest gland found in the body, and it weighs between 1and 2. 3 kg. It is located at the right upper part of the stomach. It has two lobes that is a round body part. Its two blood vessels enter the liver as hepatic portal vein that comes from the small intestine, and the hepatic artery that is oxygenated blood from the lungs. The liver has two ducts that unite to form the shared (joint) hepatic ducts that open with the pancreatic duct in the hollow side of the duodenum. The gallbladder is inside liver, it acts as storage for bile, which is formed by the liver cells. The right lobe of the liver is larger than the left. The boles divide into many tiny lobules that are made up of many liver cells. The whole liver structure is permissible with the system of blood capillaries and lymph capillaries. The liver cells do secrete bile that is collected in the bile capillaries, and then join to form bile ducts. The entire bile ducts eventually join to form the main hepatic duct. The main hepatic duct then gives off a branch that is known as cystic duct. The cystic duct goes into the gallbladder. The cystic duct joins hepatic duct while inside the gallbladder. The two ducts continue as the universal bile duct, which joins the pancreatic duct to form a shared duct, which opens into the duodenum (first section of small intestine). (Anatomy and physiology, 1999).

5. 2 Describe the role of the liver in dealing with nitrogenous waste and toxins.

The liver is like chemical processing centre which has got many functions and they includes; the production of bile, it also produces proteins, and stores glycogen, iron and some vitamins. The liver also removes toxins and waste from the blood and converts them into less harmful substances. It also regulates blood sugar, lipids and amino acids, forms plasma proteins and stores vitamins such as A and D.

When the body uses protein, it is broken down into amino acids by the liver. The by product of the used protein is ammonia which is toxin to the body. The liver then uses enzymes to convert this ammonia into urea, which goes into the blood. It is then picked by the kidneys to flow out of the body. Other disposal is through the intestines. Without the help of the liver to convert ammonia into urea, it would build up in the blood which can cause problems.

Another factor is the use of drug or alcohol. Again, the liver with the help of digestive enzymes breaks down this substance which is then disposed off by the body. These broken down toxins are eliminated from the body by converting and then excreted to the bile or blood. Through the duodenum, bile waste substances enter the intestine and eliminates from the body as faeces. Blood waste substances is also filtered from the blood by the kidneys and eliminated from the body as urine.

The liver has to convert fat soluble toxins into water soluble substances that can be excreted from the body. It filters the blood to remove large toxins, synthesizes and gets rid of bile and other fat soluble toxins and live enzymes eliminate unwanted chemicals. The process of disposing of toxins occurs by oxidations and conjugation.

Oxidation neutralizes the toxin which will then be neutralised by conjugation. This process converts a toxic chemical into a less harmful chemical.

Conjugation is the pathway where the liver cells add another substance such as sulphur molecule to a toxic chemical to make it less harmful then excretion.

6. 1 Describe the gross and ultra structure of the kidney

The gross structure of the kidney is what we can see with our naked eye. It consist of the fibrous capsule surrounding the kidney, the cortex which is a red/brown colour layer of tissue that is below the capsule and outside the pyramid and the medulla, which is the innermost layer consisting of the renal pyramids. The ultra structure is what we can not see with our naked eye. They are the functional units, the nephrons and the smaller numbers of collecting ducts.

The kidney is either of two bean shaped excretory organs that filter waste from the blood. It is located at the dorsal part of the abdomen. The left kidney lies slightly above the right. Each kidney is supplied with blood by the renal artery and drained by the renal vein. Coming out of the two kidneys are a pair of ureters which conveys urine from the kidneys to the urinary bladder for temporary storage. The last portion is the urethra which is responsible for sending urine out of the body.

The diagram below was lifted from; (www. ivy-rose. co. uk/human body), shows the gross structure of the kidney.

The kidney is reddish brown in colour and has got a deposit of fat on top of it. It can be seen to have a central cavity, the pelvis, while the surrounding mass of tissue is differentiated into an outer cortex and an inner medulla. Urine formed in the kidney passes by a pair of ureters, into the bladder where it is stored until released by the urethra.

Each kidney contains about one million nephrons which can be regarded as the functional unit performing both functions of excretion and homeostasis. At the inner end of the nephron is a spherical structure called the Malpighian body which is located in the cortex. It consists of a cup-shaped Bowman's capsule and a double layer of epithelium, enclosing a small cavity known as capsular space. The capsule then extends into a tube that coils many times to form the proximal convoluted tubule. It then descends into the medulla where it makes a u-turn known as the loop of Henley.

The tubule ascends again into the cortex, forming the distal convoluted tubule, which opens into a collecting duct, along with several other nephrons. The collecting ducts converge at the pelvis of the kidney, shedding their contents into the ureter, which carries the urine to the bladder for temporary storage. Entering the narrow opening of each Bowman's capsule is a small arteriole, which breaks up into a network of capillaries, the glomerulus. Leaving the capsule is another arteriole, which subdivides to give a network of capillaries enveloping the convoluted tubule.

6. 2 Explain the process of filtration in the nephron

The main function of the kidney is to purify the blood which flow through it. It extracts and eliminates all harmful substances and ensures it has the correct composition. This is achieved through the process of filtration, re-absorption and secretion. Because the artery bringing blood into the glomerulus is larger than that carrying blood away from it, a high pressure is built up within the glomerulus. Under this pressure, filtration occurs. This involves the forcing of substances from the glomerular capillaries through the thin wall of the Bowman’s capsule, into the lumen of the tubule. This filtrate consists of water, glucose, amino acids, vitamins, salt and urea.

The filtrate passes down to the proximal convoluted tubule where considerable re absorption occurs. Over 80% of the glomerular filtrate is absorbed including all the glucose, amino acids, water and vitamins. The process of absorbing the useful metabolites back into the blood stream is known as selective re absorption which involves active transport and passive diffusion. Active transport requires energy (ATP) which is provided by the cells of the tubule. Further waste substances may be added to the tubules by active secretion from the blood capillaries surrounding the tubules.

The Henle’s loop and distal convoluted tubule help to regulate the amount of water in the body. This is achieved by the help of a hormone known as ADH (Antidiuretic hormone) produced by the pituitary gland. The tubule also helps to regulate the pH of the blood, regulating the amount of ions in it.

When the osmotic pressure of the blood is very high, more water is absorbed from the urine. This mechanism dilutes the blood and returns its concentration to normal. At low osmotic pressure of the blood, very little or no water is absorbed in the convoluted region of the tubule. Low concentration of the blood increases its regulatory activities by forming weak or diluted urine at regular intervals but discharged in large quantities to help bring the blood concentration to normal. This regulatory activity is controlled by ADH. Its presence in the blood stream affects the collecting duct thereby regulating the amount of water in the urine.

6. 3 Explain the methods by which the kidney varies the volume and concentration of urine.

The cells of the human body are surrounded by liquid that is remarkably constant in its properties. The various metabolic processes that take place in the cells of the body require a constant internal environment. Homeostasis is the process that ensures maintenance of this internal environment. Almost all chemical activities in the body system are enzyme controlled and they work better under good condition with respect to pH, temperature and other factors.

Whenever the body’s normal temperature is altered and the condition of salt with respect to K*, Na*, C1- ions are not well maintained within the physiological limits, a number of process including nervous transmission are affected.

The regulation of the amount of water and mineral salt in the body is controlled by hormones. When the amount of water in the body is low and the body begins to dehydrate, the concentration of salt in the blood increases resulting in an increase in the osmotic concentration of blood. The brain detects this change and nerve impulses are sent to the pituitary gland to stimulate an increase in the production of ADH. This increases the permeability of cells of collecting ducts and they reabsorb more water which helps to normalise the osmotic condition of the blood.

On the other hand, when water in the body system is higher than normal, ADH production stops or reduces. Under this condition, large volumes of water are discharged together with the urine into the external environment, which is known as osmoregulation.

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