

Requirements for a balanced diet



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A balanced diet is one that provides an adequate intake of energy and nutrients for maintenance of the body and therefore good health. A diet can easily be adequate for normal bodily functioning, yet may not be a balanced diet. An ideal human diet contains fat, protein, carbohydrates, vitamins, minerals, water and fibre all in correct proportions. These proportions vary for each individual because everyone has different metabolic rates and levels of activity.

Malnutrition results from an unbalanced diet, this can be due to an excess of some dietary components and lack of other components, not just a complete lack of food. Too much of one component can be as much harm to the body as too little. Deficiency diseases occur when there is a lack of a specific nutrient, although some diet related disorders are a result of eating an excess.

An adequate diet provides sufficient energy for the performance of metabolic work, although the energy food is in an unspecified form. A balanced diet provides all dietary requirements in the correct proportions. Ideally this would be 1/7 fat, 1/7 protein and 5/7 carbohydrate.

Energy is provided by carbohydrates, fats and proteins. Proteins are a provider of energy in an emergency, but are primarily used as building blocks for growth and repair of many body tissues. These energy providing compounds are needed in large quantities in our diet so are described as macronutrients.

We also need much smaller amounts of other nutrients, such as vitamins and minerals. Because much smaller quantities are needed for a balanced diet

these are known as micronutrients. Despite the small quantities needed these are essential to provide a healthy diet as they have specific roles in metabolic reactions and as structural components.

Within the cells of our body, the nutrients ingested are converted to other compounds which are then used for metabolism and other cellular reactions. Starch, a major carbohydrate is converted to glucose which can be then synthesised into fat for storage, proteins are synthesised from amino acids, and phospholipids are made from glycerol and fatty acids. However there are some organic compounds which despite being essential for a healthy diet cannot be made by cells so must be provided by diet. These are essential amino acids, essential fatty acids and vitamins.

Carbohydrates

Carbohydrates are a rapid source of energy, they are the body's fuel. The bulk of a balanced diet should be made from carbohydrates. If eaten in an excess of the dietary requirements carbohydrates are easily stored as fats in the cells, although carbohydrate is the first source of energy in the body.

An average adult requires about 12, 000kj of energy a day, most of this is supplied by the respiration of carbohydrates in the cells.

Carbohydrates are used principally as a respiratory substrates, i. e. to be oxidised to release energy for active transport, macromolecule synthesis, cell division and muscle contraction. Carbohydrates are digested in the duodenum and ileum and absorbed as glucose into cells.

Sources of carbohydrates such as starch are rice, potatoes, wheat and other cereals. Sugars are also carbohydrates, sources of sugars are refined sugar – sucrose, which is a food sweetener and preservative and fruit sugars – fructose.

If the diet lacks carbohydrate stores of fat are mobilised and used as an energy source.

Lipids

Lipids are a rich source of energy in the diet, they can be greatly reduced in metabolic reactions and therefore release much energy. They are easily stored in the body and can form a layer beneath the skin of adipose tissue. As lipids are such a rich source of energy they are often not needed for respiration if there are adequate quantities of carbohydrate for the energy output of the body.

Meat and animal products are rich in saturated fats and cholesterol, plant oils are rich in unsaturated fats.

As lipids are digested in the intestine into fatty acids and glycerol, some fatty acids are only available in the diet and cannot therefore be synthesised in the cell in any way. These are therefore known as Essential Fatty Acids. Fatty acids are categorised according to the number of double bonds they have in their carbon chain. Saturated fatty acids have none, monounsaturated fatty acids have one, polyunsaturated fatty acids have more than one. Essential polyunsaturated fatty acids cannot be synthesised in the body from anything else as the correct enzymes to add double bonds after the ninth carbon to

the carbon chain are not present. Two essential fatty acids are linoleic and linolenic acid which are found in vegetable oils such as soya, sunflower and maize.

Fatty acids are needed for the formation of cell membrane phospholipids and also for the production of steroid hormones such as prostaglandins and thromboxin which have important roles in the renal, immune and circulatory systems as signalling chemicals.

Deficiencies of essential fatty acids result in limited growth in children, poor healing of wounds, scaly skin and hair loss.

Obesity is a result of a high fat intake in the diet and lack of exercise.

Obesity is in fact a form of malnutrition as the diet is not balanced. The risk of developing diseases such as diabetes, hypertension, CHD, arthritis (due to extra pressure on joints), stroke and some cancers are increased dramatically with obesity.

Proteins

Protein is not a direct source of energy in the body, it is used primarily for growth and repair of body tissues although can be used as an energy source as a last resort. Proteins fulfil a wide variety of roles in the body, they are broken down in the stomach and intestines to amino acids which are then absorbed. The body can only form 8 amino acids to build proteins from, the diet must provide Essential Amino Acids (EAAs) which are synthesised into proteins which can be structural, i. e. collagen in bone, keratin in hair,

myosin and actin in muscle; metabolic enzymes, haemoglobin, protective antibodies and communicative hormones.

Sources of protein include meat, fish, eggs and pulses. The diet needs to provide 8 EAAs as the body is unable to synthesis proteins without these molecules. 2 other amino acids are synthesised from EAAs so if the diet lacks the original EAAs these other two will not be present either. Phenylalanine is converted to tyrosine and methionine is converted to cysteine. Cells draw upon a pool of amino acids for protein synthesis which either come from dietary protein digested and absorbed in the gut and the breakdown of body protein such as muscle. However, unlike fats and carbohydrates there is no store of amino acids for cells to draw on, any amino acid in excess of immediate bodily requirements is broken down into urea and excreted. It is therefore important to maintain the dietary intake of protein everyday. If the body lacks protein, muscle wasting occurs as muscle is broken down .

If protein is lacked in a diet a person develops kwashiorkor which is caused when high levels of carbohydrates are eaten to overcome the lack of protein in the diet. One symptom of kwashiorkor is the abnormal collection of fluid around the abdomen due to the lack of protein in the blood. The body cannot retain water by osmosis and fluid accumulates in tissues causing them to become waterlogged.

Vitamins

Vitamins cannot be synthesised by the body so must be supplied by diet. Vitamins have no common structure or function but are essential in small

amounts for the body to be able to utilise other dietary components efficiently.

Vitamins fall into two categories, fat soluble vitamins such as vitamin A, D, E and K which are ingested with fatty foods and water soluble vitamins such as the B group vitamins and vitamin C. Vitamins are known as micronutrients because only small quantities are required for a healthy diet, in fact fat soluble vitamins can be toxic in high concentrations, for example the body stores vitamin A, or retinol, in the liver as it is toxic if kept in high concentrations in the blood stream, a dose of more than 3300mg of vitamin A can be considered toxic. Water soluble vitamins such as vitamin C and B groups vitamins can be excreted in the urine if in excess in the diet.

Vitamins carry out a wide range of functions and prevent specific deficiency diseases. A diet that lacks a certain vitamin is not a balanced diet, vitamins have vital roles in the maintenance of a healthy body.

An example of a deficiency is when the diet does not contain enough, or any vitamin A.

Vitamin A is found in some animal foods such as milk, eggs, liver and fish liver oils, related compounds such as carotenoids e. g. b carotene, are in a wide variety of vegetables such as cabbages, carrots and spinach.

Vitamin A is essential to the proper functioning of the retina in the eye and the epithelial tissues. A lack of vitamin A results in dry, rough skin, inflammation of the eyes, a drying or scarring of the cornea – xerophthalmia, which occurs when the secretion of lubricating tears is stopped, the eyelids

become swollen and sticky with pus. Mucous surfaces of the eye may become eroded allowing infection to set in, leading to ulceration and destruction of the cornea. Night blindness – an inability to see in dim light can also occur. Rod cells in the retina of the eye detect light of low intensity, they convert vitamin A into a pigment, rhodopsin, which is bleached when light enters the eye. Rod cells resynthesize rhodopsin, but if there is a deficiency of the vitamin, rod cells can no longer function and the result is night blindness. Epithelial cells use retinol to make retinoic acid, an intracellular messenger used in cell differentiation and growth. Without retinoic acid epithelial cells are not maintained properly and the body becomes susceptible to infections, particularly measles and infections of the respiratory system and gut.

Xenophthalmia is common among children whose diets consist of mainly cereals with little meat or fresh vegetables, this is common in Indonesia, Bangladesh, India and the Philippines.

Vitamin D, or calciferol, is another fat soluble steroid vitamin which functions to stimulate calcium uptake from the gut and its deposition in bone. Vitamin D acts as a hormone when converted by enzymes in the gut and liver into an active form “ active vitamin D”, which stimulates epithelial cells in the intestine to absorb calcium. Vitamin D is therefore essential in growing children’s diets to enable the growth of strong bones. Without adequate amounts of vitamin D children can develop rickets, which is the deformation of the legs caused when they lack calcium to strengthen the bones. In adults a lack of vitamin D in the diet can lead to osteomalacia, a progressive softening of the bones which can make them highly susceptible to fracture.

Vitamin D is made by the body when exposed to sunlight and is stored in the muscles, however, if the skin is rarely exposed to the sunlight or is dark little vitamin D is produced. Foods such as eggs and oily fish are all rich in vitamin D.

Vitamin K, phylloquinone, is found in dark green leafy vegetables such as spinach and kale. It is a fat soluble vitamin which is involved in the clotting process of blood. In the intestines bacteria synthesise a number of important clotting factors which need vitamin K. Without vitamin K cuts can fail to heal and internal bleeding can occur.

Vitamin C is a water soluble vitamin, known chemically as ascorbic acid. It is found in citrus fruits such as oranges and lemons, and also in potatoes and tomatoes. The main function of vitamin C is the formation of connective tissues such as collagen. It is also known to be an antioxidant which helps to remove toxins from the body and aids the immune system. A lack of vitamin C leads to Scurvy, a condition experienced by sailors on long journeys when they did not have fruit in their diets. Scurvy causes painful, bleeding gums. As vitamin C is water soluble, it is not toxic in high doses as it can be excreted in the urine, very high doses can however cause diarrhoea.

B group vitamins have a wide range of roles acting as co-enzymes in metabolic pathways. They are found in most plant and animal tissues involved in metabolism, therefore foods such as liver, yeast and dairy products are all rich in B group vitamins. Deficiency of B group vitamins include dermatitis, fatigue and malformation of red blood cells.

Minerals

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Some minerals are considered to be macronutrients as they are required in fairly large amounts in the diet to maintain a healthy body. Minerals are required in their ionic state in the diet.

Calcium, Ca^{2+} , is a major constituent of bones and teeth and is required to keep bones strong. It is required in blood clotting as an activator of various plasma proteins and is also involved in muscle contraction. Calcium is used in synapses and also as an enzyme activator. A good source of calcium is in dairy products, eggs and green vegetables, the RDA for calcium is 800mg.

Chlorine, Cl^- , is required to maintain the osmotic anion / cation balance of the body and the formation of HCl in the stomach. It is found in table salt and is rarely deficient in the diet as it is used as a preservative to many foods.

Sodium, Na^+ , is also found in table salt as well as dairy foods, meat, eggs and vegetables. Sodium is used in conjunction with chlorine in the maintenance of the osmotic anion / cation balance. It is also needed in nerve conduction and muscle action. Potassium, K^+ , is yet another mineral required in nerve and muscle action, it also has a role in protein synthesis. It is found in meat, fruit and vegetables.

Phosphorus, in the form of phosphate, PO_4^{3-} is a constituent of nucleic acids, ATP, phospholipids in cell membranes, bones and teeth. It is present in dairy foods, eggs, meat and vegetables.

Magnesium, Mg^{2+} , is an important component of bones and teeth and is also an enzyme activator. It is found in meats and green vegetables.

Micronutrients are minerals needed in trace quantities. Despite the small quantity required, they are still essential to a healthy balanced diet.

Iron, in the forms of Fe^{2+} and Fe^{3+} , are required in the formation of haemoglobin and myoglobin. Iron is a constituent of many enzymes as a prosthetic group and also as an electron carrier in mitochondria. Red meat, liver and green vegetables are all sources of iron. Iron supplements are taken by people who suffer from anaemia.

Iodine, I-, is a component of the growth hormone thyroxine. A lack of iodine in the diet can cause hypothyroidism which results in weight gain and in extreme cases a lack of physical and mental development known as cretinism. A swelling of the neck can occur which is called goitre if iodine is deficient in the diet. Iodine can be found in seafood such as shellfish, seaweed and fish. Iodine has also been added to water supplies in areas where it is deficient in the main water system.

Copper, Cu^{2+} , manganese, Mn^{2+} and cobalt, Co^{2+} , are all needed in the diet to form co-factors for enzymes. Copper is also needed for bone and haemoglobin formation and cobalt is needed for the production of red blood cells, manganese is also a growth factor in bone development. They are found in meat and liver as well as some dairy products.

Fibre

Fibre is not digested by the body, but is involved in maintaining the health of the gut and is therefore an essential part of a balanced diet. Fibre is mostly made up of cellulose from plant cell walls and is indigestible as the stomach

and gut do not contain the correct enzymes. Fibre aids the formation of faeces, preventing constipation. It also aids the peristaltic movement in the intestine and has been linked to the prevention of bowel cancer. Fibre also removes some saturated fats and cholesterol therefore protecting the body a little from the build up of plaques in blood vessels. Fruit, vegetables and cereals are a good source of dietary fibre.

Water

The diet must provide water which is required as a solvent, a transport medium, a substrate in hydrolytic reactions and for lubrication. Water in fact makes up about 70% of the total body weight of humans. Water is needed as it is lost constantly from our bodies in urine, sweat, evaporation from lungs and in faeces. An average person requires 2-3 litres of water a day which is supplied through drinks and liquid foods. Without water or food the longest anyone has ever survived is 17 days, however, with water the longest anyone has survived is 70 days, this illustrates the importance of water in the diet.

As you can see a balanced diet is imperative to maintaining a healthy body. People who choose to be vegetarians and vegans therefore must make sure that their diet contains all the correct nutrients to avoid any deficiencies that may occur, as well as people living in countries where their diet lacks certain important food groups. A diet can easily be adequate without being a properly balanced diet and since everyone has different metabolic rates everyone's ideal diet is unique, therefore generalised guidelines have been established to aid people in obtaining a good diet. Vitamins and minerals are

required in small amounts to carry out a variety of essential specific functions, fat and carbohydrates are the main fuel that the body runs on, whilst protein is needed in large amounts for growth and repair. The diet must also provide adequate quantities of essential fatty acids and amino acids which are required for the body to metabolise into proteins and are fundamental for health. Over eating of one food group is considered to be a form of malnutrition because the diet is not balanced.