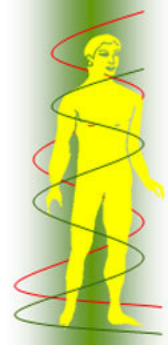


# Minerals and Vitamins



Nutrients are elements or compounds which contribute to our metabolism. We provide our body with nutrients from the food in our daily diet. Depending on the variety, quality and quantity of food we eat and our lifestyle, the diet will have direct consequences on the health of our body making it a major actor in a healthy life.

Nutrition should be integral part of the healing process. Many homeostatic imbalances are related directly or indirectly to bad nutrition habits. Unfortunately the awareness of this factor amongst people is not developed so that most people continue to feed themselves on foods that are unhealthy for their metabolism.

Nutrition deficiency is when the diet does not provide enough of one or more nutrients to our body so as to allow homeostasis or when the nutrients in our diet are either of poor quality or when imbalances in our body do not allow correct metabolism of these. Nutrition deficiency does not automatically result from "eating too little". Some people who eat "plenty" or "enough" may suffer from deficiency because they are not eating the "right" things and/or are not leading a "healthy" life.

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## Macronutrients

are those nutrients that together provide the vast majority of metabolic energy to the body. The three main macronutrients are **carbohydrates, proteins** and **fats**.

Furthermore **water** which comprises about 60% of the volume of food we eat and **fiber** which is the indigestible part of the diet that comes from plants and meat (bran, cellulose and other polysaccharides) are also macronutrients.

**Fats** are the main source of energy for the body.

Fats stored in our body in the adipose tissue store twice as more energy than the equivalent of Carbohydrates or Protein would. However fat metabolizes slowly therefore the energy released by fat within the adipose tissue can only be used when we exercise at lower level of activity. Fatty acids used as metabolic regulators (e.g, lower blood pressure, diuresis, rise of body temperature, gastric secretion). Cholesterol is synthesized from fats and is used by our body in

**Fiber** stimulates the peristaltic action (bowel movements) and by attracting water it increases the bulk and softness of the faeces so avoiding constipation. It also increases the bulk of food in the stomach thereby increasing satiety.

**Proteins** are a key component to the structure of the body. They are present in muscle, bones, connective tissue, blood cells, glands and organs. They are the source of amino acids to our body. Proteins allow the formation of Enzymes. Almost all enzymes are proteins. This means that proteins are essential in most chemical reactions which occur in our body including: digestion of nutrients, regulation of energy, production in cells, and synthesis of all chemical substances found in the body. The maintenance of equilibrium within the body environment is achieved by the action of various proteins operating in specific ways:

1. Hormones are amino acids that act as messengers to the various organs they control e.g. response to stress

many ways such as: in the synthesis of steroid hormones including those produced by the adrenal gland and sex hormones; in the formation of vitamin D in the skin; in producing bile salts in the liver for digestion of fats.

Fats allow transport and storage of fat-soluble vitamins A, D, E and K.

Storage of fat as energy reserve has also the convenient side effect that it offers insulation and protection. Many vital organs such as kidneys, spleen, spinal cord and brain are protected by adipose tissue whilst subcutaneous fat protects the body from

(adrenaline)

2. Acid-base balance and therefore a nearly constant pH are obtained when proteins accept and donate Hydrogen+ ions.
3. Fluid balance is controlled by proteins (albumin and globulin) using osmotic pressure to hold fluid within the circulation.
4. Immunity depends greatly on proteins. These are needed for cell division and antibodies.

Proteins allow for carrying substance around the body (e.g. hemoglobin transports oxygen). Some proteins present in the plasma allow blood. An example of other functions of proteins: they produce energy if insufficient carbohydrate or fat is available, our nails and hair are mainly proteins.

the external environment in helping maintain body temperature.

Fat soluble vitamins are also stored in adipose tissue. Many membranes are made of fat molecules in combination with other molecules such as phosphate, carbohydrates, cholesterol and protein. On our skin fats have waterproof and anti-bacterial properties. Fats contribute to postponing the return of hunger by increasing the time span in which the stomach contents are emptied into the small intestine.

**Carbohydrates** are an important source of energy for our body mainly in the form of glucose (for immediate use) or glycogen (stored in the liver for reserves) which are used by all cells of the body in particular by brain, nervous system and developing blood cells. It is the major fuel used by the cells.

**Water** is essential to maintain the moist internal environment required by all living cells in the body. It participates in all chemical reactions within and out of the cells. Dilution and moistening of food facilitates the peristaltic action (bowel movements); it allows to expel waste (urine and faeces), allows transport of chemicals to and from the cells within blood and tissue fluids. Water allows maintenance of body temperature (sweat).



## Micronutrients

are essential elements only needed by life in small quantities. They include Vitamins and Minerals.

**Vitamins** are organic chemicals that a given living organism requires in trace quantities for good health, but which the organism cannot synthesize, and therefore must obtain from its diet.

**Microminerals** or **trace elements** are dietary minerals needed by the human body in very small quantities (generally less than 100mg/day) as opposed to macro minerals which are required in larger quantities.

zymes and breakdown of protein, carbohydrate and fat. Vitamin B1 is not stored at all in our body therefore we greatly depend on daily intake of the vitamin. Vitamin B2 is required for red blood cells formation and respiration, antibody production, and for regulating human growth and reproduction. It is essential for healthy skin, nails, hair growth and general good health, including regulating thyroid activity. Vitamin B3 is an antioxidant for the liver, regulates blood glucose levels, promotes reduction of cholesterol and fats in the blood. Vitamin B5 is also an antioxidant. Vitamin B6 is vital for our good health because more than 100 enzymes use it. It is also essential for production of hemoglobin (red blood cells). The nervous and immune systems need vitamin B6 to function efficiently and it helps to maintain blood glucose levels within a normal range. Vitamin B7 not only assists in various metabolic chemical conversions, but also helps with the transfer of carbon dioxide. It is also helpful in maintaining a steady blood sugar level. Vitamin B9 is necessary for the production and maintenance of new cells. This is especially important during periods of rapid cell division and growth such as infancy and pregnancy. Both adults and children need Vitamin B9 to make normal red blood cells and prevent anemia. Vitamin B12 is important to the nervous system by acting on the insulation sheath that surrounds nerve cells and facilitates the conduction of signals in the nervous system. It is also needed for red blood cells and to help make DNA.

## Fat-soluble vitamins

The properties of fat-soluble vitamins are that they are found only in fatty or oily foods, their absorption and transport from the digestive tract requires secretion of bile and normal fat absorption mechanism to be functioning. They require lipid soluble carriers for transport in the blood. They are stored in adipose tissue or in the lipid components of cells, they are not excreted in water and therefore are stored in the body in the liver and adipose tissue. The fat-soluble vitamins comprise: Vitamin A (Retinoic Acid), Vitamin D (Calciferol), Vitamin E (Tocopherol), Vitamin K (Naphthoquinone).

**Vitamin A** Is found in eggs, butter, milk and milk products, liver, fish or fish oils. It helps our vision, allows for gene differentiation, controls secretions (eyes, lungs, digestive tract lining...); is required for normal growth, regulates reabsorption and deposition of bone; is an antioxidant; has a key role in immunity; red blood cell formation; and utilization of iron.

**Vitamin D** contributes to the maintenance of normal levels of calcium and phosphorus in the bloodstream. Human skin can manufacture it in some circumstances. It helps absorption of calcium, allows appropriate amounts of calcium and phosphorus to be available in the bones and allows calcium reabsorption in the kidneys. It is also suggested that Vitamin D may play a role in other organs such as brain and nervous system.

**Vitamin E** is a powerful antioxidant (limits and stops free radical reactions). It donates hydrogen and therefore becomes oxidized whilst preventing the oxidation. It therefore prevents cell membranes from oxidizing and losing the function. It is important for those parts of the body where large amounts of oxygen are present including lungs and red blood cells.

## Water-soluble vitamins

The water-soluble vitamins are absorbed into the portal blood. When present in excess they are excreted in the urine. The body has limited storage capacity for these vitamins (except for B<sub>12</sub>). They are most readily lost during food preparation processes (exposure to heat, light and air). The water-soluble vitamins comprise: Vitamin B<sub>1</sub> (Thiamin), Vitamin B<sub>2</sub> (Riboflavin), Vitamin B<sub>3</sub> (Niacin), Vitamin B<sub>5</sub> (Pantothenic Acid), Vitamin B<sub>6</sub> (Peridoxine), Vitamin B<sub>7</sub>, (Biotin), Vitamin B<sub>9</sub> (Folic acid), Vitamin B<sub>12</sub> (Cyanocobalamin), Vitamin C (Ascorbic acid).

**Vitamin B's** help regulate metabolic reactions, some support the production of en-

**Vitamin C** is not stored and therefore we require a daily intake. It is needed for the production of collagen in the connective tissue. It manages our stress levels because it is required for synthesis of dopamine, noradrenalin and adrenaline in the nervous system or in the adrenal glands. Vitamin C is also needed important for the transfer of energy within the cells. It is a strong antioxidant.



## Calcium

is the most abundant mineral in the human body. Most of it is found in the bones and teeth where its function is to support the body structure. However calcium also needed for muscle contraction, blood vessel contraction and expansion, the secretion of hormones and enzymes, and sending messages through the nervous system. Calcium is essential for blood clotting so if calcium levels are insufficient blood will not clot. Deficiency can cause bone loss (Osteoporosis). There is some evidence that it may reduce colon cancer and lower blood pressure.

### Food Sources

- Milk
- Diary products
- Cereals
- Cereal products
- Green leafy vegetables (e.g. spinach, broccoli)
- Small fish whose bones can be eaten (e.g. sardines)
- Dried figs
- Nuts
- Parsley
- Watercress
- Calcium rich water

### Absorption of calcium

#### Enhancing factors

The most important is Vitamin D because it allows for the transport of calcium into the blood. Lactose (present in milk) enhances its absorption because it keeps calcium in a soluble form. The acidity in the upper digestive tract also facilitates the solubility of calcium therefore taking ant-acids will compromise calcium absorption.

#### Inhibitory factors

There are some elements which are present in foods that contain calcium that tend to inhibit its absorption. Phytates (in whole cereals and whole grain breads) and Oxalates (in spinach, rhubarb, beetroot, chocolate, tea infusions, wheat bran, peanuts and strawberries). Also unabsorbed fats will combine with calcium and flush it out of the body.

### Health aspects of calcium

#### Osteoporosis

It is the loss of bone mass and density with age resulting in fragile bones which are susceptible to fractures. Wrist, hips and spine are mostly affected by osteoporosis.

Current evidence suggests that the most desirable method of prevention is to achieve a high "peak bone mass" by the age of 20-25 so that the critical point for fracture is not reached when bone is lost in later life.

The following factors will contribute to achieve "peak bone mass" in young adults: weight bearing exercise (e.g. walking), control of body weight, avoid alcohol and smoking since these reduce bone accretion, adequate exposure to sunlight (Vitamin D) and a diet which avoids elements that inhibit the absorption of calcium.

#### Blood pressure

Several studies have shown that individuals that have high intakes of calcium (in particular from dairy products) have lower blood pressure. Calcium supplementation can also therefore lower blood pressure.

#### Colon Cancer

There is evidence that calcium may reduce the incidence of colon cancer since it seems that bile acids and fatty acids bind to unabsorbed calcium and thus are removed from the colon.

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## Magnesium

### Food Sources

- Whole grain
- Nuts
- Legumes
- Seafood
- Coffee
- Tea
- Cocoa
- Chocolate
- Green leafy vegetables

60% of the magnesium in our body is found in the bones. The rest is distributed over tissues and organs and a small amount in the blood. It helps maintain normal muscle and nerve function, keeps heart rhythm steady, supports a healthy immune system, and keeps bones strong. Magnesium also helps regulate blood sugar levels, promotes normal blood pressure, and is known to be involved in energy metabolism and protein synthesis (production of proteins).

### Absorption of magnesium

As for calcium the absorption of magnesium is improved by Vitamin D and inhibited by the presence of phytates and fatty acids. There are many situations in which magnesium competes with or interferes with the action of calcium in the body (e.g. it inhibits blood clotting whilst calcium promotes it). However some

functions require both calcium and magnesium to function correctly (e.g. parathyroid hormones). Magnesium deficiency is mainly a secondary to other problems in the body such as inadequate protein intake, prolonged intravenous feeding, excessive vomiting, diarrhoea or use of diuretics.



## Iron

Iron is an essential component of proteins involved in oxygen transport from the lungs to the tissues (haemoglobin). It is also essential for the regulation of cell growth and differentiation. It is found predominantly in the bone marrow for red blood cell production, in muscle cells for myoglobin production, for production of mitochondria and cytochromes in active cells, in production of hormones and neurotransmitters. Finally it also has immune function.

### Absorption of iron

There are two forms of iron in the diet that are absorbed with different efficiency. The Organic iron (heme) is absorbed relatively easily (however the process is slow) whilst the Inorganic iron (non-heme) must be made soluble before absorption and this is done by the Hydrochloric acid in the stomach and in combination with vitamin C. Inorganic iron absorption can be also improved by including citric acid, lactic acid, fructose and peptides derived from meat.

Iron absorption can however be reduced when combined with phytate (in whole cereal grains), polyphenols (in tea, coffee and nuts), oxalic acid (in tea, chocolate, spinach), phosphates (in egg yolk), calcium and zinc.

Once absorbed there is no way of eliminating surplus of iron, which can if in excess become toxic to the body. Iron is stored then in the liver, bone marrow and spleen.

### What is iron deficiency

Iron deficiency anaemia occurs when iron stores become depleted. The supply in iron for the production of new red blood cells will become inadequate and the cells produced will contain less haemoglobin and be smaller and fewer in number. When the number of red blood cells becomes so low that the oxygen-carrying capacity to the tissues is affected, the person will suffer from the symptoms of anaemia including fatigue, apathy, loss of appetite and poor temperature regulation. There might also be problems with digestion and the nails become brittle. In addition it will also affect the person on a physical level reducing the capacity to physical work, poor memory, learning and low attention span. An interesting aspect is that with iron deficiency the immune system is also depressed because the phagocytes (those cells that eat up bacteria!) are not as efficient. However since iron is also required for bacterial growth the iron deficient environment should protect from bacterial infection. The problem here is that as iron supplementation treatment starts without an associated improvement of the immune function then the result is quick and sometimes fatal infections. It has recently been suggested that restless leg syndrome could also be related to iron deficiency.

### Causes of iron deficiency

- **Blood loss** (e.g. heavy menstruation, peptic ulcer, a kidney or bladder tumour, a colon polyp, colorectal cancer, or uterine fibroids, Gastrointestinal bleeding can result from regular use of aspirin or other non-steroidal anti-inflammatory drugs)
- **Lack of iron in the diet**
- **Inability to absorb iron** (e.g. intestinal disorder such as Crohn's disease, some medication such as antacids)
- **Pregnancy** (because of an increased blood volume)
- **Lack of certain vitamins/minerals** will not allow iron to be absorbed: B12, B6, B9 and A as well as Zinc.

### Some foods rich in Iron

Meat, liver from organically raised cattle, fish, egg yolks, blackstrap molasses, dark-green vegetables (e.g. lettuce, spinach, alfalfa, asparagus, cabbage, broccoli, parsley, celery, kale, cucumbers, leeks and watercress), dried fruit (e.g. apricots, raisins, figs, dates, peaches, prunes and pears), cherries, berries, bananas, grapes, apples, beets, carrots, yams, legumes, whole grains, rice, wheat, black cherry juice, grape juice.

Enhance the diet by drinking citrus juice which enhances absorption of iron and taking extra vitamin C.



## Sodium and Potassium

These minerals are essential for cellular integrity and the maintenance of fluid, electrolyte and acid-base balance in the body. Potassium is also involved in the propagation of the nerve impulses and muscle contraction. Sodium plays a crucial role in allow fluid osmosis in the body (meaning it manages how fluids are transported from the circulatory system to the tissues).

An increased intake of sodium tends to increase blood pressure whilst potassium has been shown to reduce blood pressure. A diet low in sodium will most likely lower the incidence of stroke.

Sodium and potassium regulate the excretion of minerals and water via the kidneys. This process is controlled by hormones (aldosterone, rennin-angiotension or antidiuretic). If this process is not functioning adequately serious illness can occur (e.g. edema).

The main source of salt is comes from the salt added to our diet whilst potassium is mainly found in vegetables (dried fruit and nuts, raw vegetables) and potatoes.

- Chloride** Chloride is generally found together with sodium and is the major anion of extra cellular fluid. It however also associates with potassium and like sodium allow electrochemical gradients across cell membranes. It is essential for the transport of carbon dioxide in red blood cells m in the formation of hydrochloric acid secreted in the stomach.
- Potassium** Potassium is the major intra cellular cation of the body. It is essential for cellular integrity and maintenance of fluid, electrolyte and acid-base balance within the cells.
- Sulfur** Sulfur is required for synthesis of proteins and is a connective tissue constituent for those parts of the body such as skin, nails and hair. It has also an important detoxifying role in the liver.
- Zinc** Zinc is important in prostate function and is needed for the growth of the reproductive organs. It helps prevent acne and promotes a healthy immune system. It helps in the healing of wounds, improves the sense of taste and smell, protects the liver against chemical damage and is vital for bone formation. Zinc is a constituent of insulin and many vital enzymes, acts as an antioxidant and promotes concentration.
- Copper** Copper is essential for iron metabolism and is a component of enzymes which contribute to free-radical-quenching, response to infection and neurotransmitters.
- Selenium** Selenium is an important cofactor of proteins allowing them to develop antioxidant properties to prevent cellular damage from free radicals.
- Iodine** Iodine is required for the production of thyroid hormones which maintain metabolic rate, cellular metabolism and integrity of connective tissue. In the fetus the hormones are necessary for the development of the nervous system.
- Chromium** The effects of this mineral have not yet been researched extensively however it is known to enhance the action of insulin.
- Fluoride** Fluoride is essential for the production of hard, caries-resistant enamel in the teeth
- Cobalt** It is a component of enzymes. It is an essential component of Vitamin B<sub>12</sub>.
- Manganese** It is a component of enzymes.
- Molybdenum** It is a component of enzymes.