



Diet Specialist

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Online Nutrition Training Course

Module 5: Vitamins and Minerals



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Aims of the section:

- 1) Understanding the definition of vitamins, minerals and trace elements.
- 2) Understanding the function of vitamins, minerals and trace elements.
- 3) Examining the definition of fat soluble vitamins such as A, D, E and K.
- 4) Understanding what water soluble vitamins are including C, B vitamins and folic acids.
- 5) Understand the minerals that each individual should consume.
- 6) Understand what trace elements are.
- 7) Explore practical tips on how to increase vitamin and mineral intake.

Vitamins - definition and function

Vitamins are only required in very small quantities which is just a few micrograms or milligrams per day. They are a diverse range of chemicals, however they are not chemically related but they are essential for key processes that are carried out by the body.

Vitamins are not chemically related. The classification of vitamins was originally with a letter, and once a chemical structure was identified a specific chemical name could be identified. However it should be noted that some vitamins consist of a family of related compounds such as vitamin A and D whilst others are single chemicals such as vitamin C also referred to as ascorbic acid.

Classification according to principal functions and actions in the



body can be a useful way of describing roles and predicting the effects of inadequate intakes. Some vitamins, e.g. many of the B group, act as cofactors (a substance whose presence is essential for the activity of an enzyme) for enzymes required in energy production pathways. Other vitamins have actions that are specific to the development or maintenance of body tissues, e.g. blood (folate and vitamin B12) or bone (vitamin D). In addition to such functional roles, vitamins have been described through possible effects on general systems such as the description of antioxidant functions (molecules that inhibit the oxidation of other molecules) for ascorbic acid and vitamin E.



Another way to classify vitamins is based on how well they dissolve, ie their solubility in water or in lipids such as fat. Those classed as water soluble include the B group vitamins and vitamin C (ascorbic acid) and those classified as lipid soluble (fat-soluble) vitamins are vitamin A (retinol), vitamin D (cholecalciferol), vitamin K and vitamin E (tocopherols). Some of the benefits of this type of classification includes a better understanding of their function, distribution in the body, potential toxicity and their food sources.

Characteristics of fat-soluble and water soluble

Some of the differences in the characteristics of each type of vitamin include:

	Fat-soluble vitamins	Water-soluble vitamins
Risk of deficiency	Deficiency may occur where a diet is low in fat as well as when the absorption of fat has been impaired.	There may be risk of deficiency where when a diet lacks in variety
Stability in foods	Fat-soluble vitamins are robust in foods and do not get affected by heat and light	Generally speaking these types of vitamins are quite labile (susceptible to change) to heat and light or lost in water used for cooking. Therefore best to steam or grill.
Storage in body	These vitamins can be large and long term with regards to storage which is why they do not need to be eaten every day.	The body does not store these types of vitamins well and hence regular intake is required.
Risk of toxicity	High. The body can store them up ready for when required. If more is consumed than needed it can be harmful and thus caution is needed with supplementation.	Low. The body gets rid of high intake of these vitamins through urination and therefore the risk of toxicity through excess consumption is low

There are two types of vitamins discussed below with their functions, sources and requirements.

The fat soluble vitamins

These include:

- Vitamin A
- Vitamin D
- Vitamin E
- Vitamin K



Name of vitamin	Function of vitamin	Where food found
Vitamin A (Retinol or Beta-carotene)	Eye health, bone development, protection of the respiratory, digestive and urinary tract linings, and maintains healthy skin and hair. Beta carotene fights free radicals (chemicals that damage cells).	Liver, egg yolk, dairy products, margarine. Beta carotene (pro-vitamin A) is found in dark green and deep yellow fruits and vegetables.
Vitamin D (Cholecalciferol)	Builds strong bones and teeth and maintains the nervous system.	For most people, sun exposure is the primary source of vitamin D. Food sources include vitamin D-fortified milk, eggs, fish-liver oils and fatty fish such as herring, mackerel and salmon.
Vitamin E (Tocopherol)	Protects the lungs, nervous system, skeletal muscle and the eye's retina from damage by free radicals; may reduce risk of heart disease by protecting against atherosclerosis.	Vegetable oils, nuts, wheat germ and whole-wheat products, egg yolks and green leafy vegetables.
Vitamin K	Promotes normal blood-clotting.	Dark green leafy vegetables, eggs, cheese and liver.

Water soluble vitamins

These include:

- Vitamin C
- Vitamin B
- Folic acid

Name of vitamin	Function of vitamin	Where food found
Vitamin C (Ascorbic Acid)	An antioxidant fights and resists infection, heals wounds, promotes growth and maintenance of bones, teeth, gums, ligaments and blood vessels.	Almost exclusively fruits and vegetables (especially citrus fruits, tomatoes, peppers, strawberries, and cantaloupe) although breast milk and organ meats contain small amounts.
Vitamin B1 (Thiamine)	Promotes healthy functioning of the nerves, muscles and heart and metabolises carbohydrates.	Whole grains, cereals and enriched grain products; also legumes (dried beans, peas, and nuts), organ meats, lean pork and eggs.
Vitamin B2 (Riboflavin)	Metabolises carbohydrates, fats and proteins, produces hormones, and promotes eye and skin health.	Organ meats, enriched breads and cereals, legumes, almonds, cheese, eggs, meat, fish and dark green vegetables.
Vitamin B3 (Niacin)	Metabolises carbohydrates and fats, helps functioning of digestive system and maintains health skin.	Meat, organ meats, whole grains and cereals, and legumes, eggs, milk, green leafy vegetables and fish.
Vitamin B5 (Pantothenic Acid)	Produces hormones and maintains the body's immune system.	Organ meats, yeast, raw vegetables, eggs and dairy products.
Vitamin B6 (Pyridoxine)	Metabolises protein, helps produce haemoglobin, and promotes functioning of digestive and nervous systems, and healthy skin.	Whole-grain products, poultry, fish, nuts, meat, most fruits and vegetables, eggs and dairy products.
Vitamin B12 (Cyanocobalamin)	Builds genetic material of cells and produces blood cells.	Primarily organ meats as well as fish, lean meats, poultry, cheese, and eggs.
Folic acid (folate)	Folate works with B12 to form healthy red blood cells, thus preventing central nervous system defects such as Spina bifida in unborn babies, caused by the incomplete closing of the embryonic neural tube. Therefore it is recommended as a supplement during conception up until the first trimester.	Broccoli, brussels sprouts, liver, spinach, asparagus, peas, chick peas, brown rice and fortified breakfast cereals
Vitamin B7 Biotin	Biotin works with several enzyme systems involved in the synthesis of fatty acids and in gluconeogenesis	Egg yolk, liver, kidney, nuts, pulses, wholegrain cereals and yeast

Minerals

Like vitamins, these are essential for the normal function of the body, however they are only required in small or even trace quantities. Those required in milligram quantities (sometimes several hundred milligrams) tend to be referred to as minerals. Those required in smaller amounts (microgram quantities) are usually called trace elements.



Functions of mineral and trace quantities

They have a variety of roles and may be necessary for:

1. **Structure of tissues:** iron is essential for the production of haemoglobin in the blood and phosphorus and calcium are required as structural components of bones.
2. **Enzyme systems:** Minerals are the catalysts that enable enzyme systems to operate, either by being part of the enzyme itself or function as a cofactor which enables the enzyme to work properly.
3. **Fluid balance:** for there to be fluid balance within the body, the regulatory mechanism needed to achieve this is driven by the concentration of elements such as sodium and potassium in body fluids and their movement between extracellular and intracellular compartments.
4. **Function of the cells:** some minerals are required for inter and extracellular transport mechanism and the stability of membranes.
5. **Neurotransmission:** Some have an essential role in nerve function and influence electrical activity.

Difficulties in estimating the amount absorbed

The absorption of minerals by the body is influenced by a number of factors. Not only are there differences between minerals and trace elements in terms of the extent to which a nutrient can be used by the body, known as bioavailability, but they are also influenced by the following factors:

- **Their dietary source:** calcium in vegetables and cereals is absorbed less effectively than calcium in milk.
- **Chemical form:** Haem iron is found in meat and non-haem is found in foods of vegetable origin. Haem iron is absorbed more effectively than non-haem iron.
- **Inhibition of absorption when other components are present:** minerals and trace elements can form un-absorbable complexes when they combine with phytates, oxalates or some types of fibre.
- **Enhancement of absorption when other components are present:** an example of this is the presence of vitamin C which improves the absorption of non-haem iron.
- **Other minerals consumed:** some minerals compete for the same absorption site, hence if one is consumed, this may affect the absorption of the other. An example of this is iron and zinc.
- **Level of intake:** absorption increases when the level of dietary intake is low and conversely it decreases when the level of intake is high.
- **Physiological factors:** absorption may increase with a physiological need such as pregnancy, lactation (the secretion or formation of milk) or conditions of depletion.
- **Age:** as the age of the individual increases, the level of absorption decreases.



Essential minerals

These are named essential as they are essential components of the human diet. They include:

- Calcium
- Phosphorus
- Magnesium
- Sodium
- Potassium
- Iron
- Zinc

Name of mineral	Function of mineral	Where food found
Calcium (Ca)	Builds bones and teeth, promotes blood clotting, contraction of muscles and nerve impulses.	Primarily in milk and dairy products but also found in dark-green vegetables, legumes, shellfish, fish with edible bones, tofu and calcium-fortified orange juice.
Phosphorus (P)	Present in all cells of the body with a close link to calcium and protein metabolism. Also releases oxygen and energy into the cells and mediation of intercellular hormones.	Milk and milk products, cereal products, meat and meat products, vegetables and potatoes.
Magnesium (Mg)	Builds bones and teeth, involvement in functioning of muscular and nervous systems, as well as hearing and circulatory system.	Legumes, whole-grain cereals, nuts, dark-green vegetables, meat, seafood and dairy products.
Sodium (Na)	Found in fluid external to the cells and plays an important role in blood pressure, fluid balance and transmembrane gradients (relative concentration across membranes). Many foods contain small amounts of sodium but none contain large amounts. Can increase radically when food is preserved because of salt addition or other sodium containing additives such as sodium bicarbonate, sodium nitrate or mono-sodium glutamate.	Bread and other cereals, meat and meat products in particular ham, and bacon, products in brine, milk and milk products including cheese and butter, pickles, sauces, smoked fish salted foods and yeast extracts.
Potassium (K)	Helps nerves and muscles function, regulates heart's rhythm and regulates bodily fluids.	Potatoes, dried fruits, bananas, legumes, raw vegetables, avocados and mushrooms, lean meat, milk and fish.
Iron (Fe)	Helps produce haemoglobin and red blood cells, delivers oxygen to muscles and other body tissues and protects against effects of stress.	Iron is poorly absorbed from food. The richest sources are red meat and organ meats. Other sources include whole-wheat products, shellfish, nuts and dried fruit. Many breads and cereals are enriched with iron. Vitamin C aids absorption of iron and is often added to iron supplements.

Zinc (Zn)	Involved in growth, skin health and wound healing, development of the reproductive organs, protein metabolism and energy production.	Shellfish (particularly oysters), organ meats and lean red meat, yeast, whole-grain cereals, and legumes.
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Trace Elements

Only trace elements are required of these minerals, which include:

- Copper
- Chromium
- Manganese
- Molybdenum
- Selenium
- Iodine



Name of mineral	Function of mineral	Where food found
Copper (Cu)	Builds bones, red blood cells and haemoglobin, metabolises iron, maintains connective tissue and blood vessels.	Organ meats, shellfish, whole-grain products, legumes and dried fruits.
Chromium (Cr)	An essential nutrient required for normal sugar and fat metabolism, which influences how hormone insulin behaves in the body. May also help prevent high cholesterol and atherosclerosis.	Whole wheat and other whole grains and molasses.
Manganese (Mn)	Helps produce and activate some of the enzymes in the body as well as a component of bone and cartilage	Tea, bread, nuts, cereals, green vegetables peas and runner beans.
Molybdenum (Mo)	Makes and activates some enzymes used in repairing and making genetic material	Nuts, tinned vegetables, cereals, peas, broccoli, spinach and cauliflower.
Selenium (Se)	An antioxidant, which helps protect cells and tissues from damage by free radicals (highly reactive molecule which can damage cells when produced in excess); may also protect against some cancers.	Whole-grain cereals, fish and shellfish, meat and dairy products.
Iodine (I)	Thyroid gland functioning and thyroxin functioning of thyroid hormone. Maintenance of metabolic function, thermal regulation, protein synthesis and integrity of protective tissue.	Sea vegetables, yoghurt, cow's milk, eggs, fish and shellfish.

Tips on how to increase vitamins and minerals intake in diet.

- Aim to have 5 different portions of fruits and vegetables per day. A portion of fruit, approximately 80g or a handful equates to one apple, orange, pear, nectarine, kiwi or small banana. A portion of vegetables is approximately 3 heaped tablespoons, a small bowl of salad, 150g carrots, turnip, swede, cabbage, spring greens, cauliflower or broccoli, or 2 tablespoons tinned/stewed fruit in natural or fruit juice. With regards to dried fruit it is 3-4 dried apricots, prunes, figs or apple rings, and 150ml (small glass) of unsweetened juice.
- Keep healthy snacks easily to hand (e.g. fresh fruit in a bowl, fruit salad).
- When hungry snack on raw vegetables such as cucumber, celery or carrots.
- Try to load up on freshly squeezed juices instead of a usual coffee, tea or cola but be aware of the natural sugars in fresh orange juice.

- Use plenty of vegetables, and pulses while making soups, and try to put some extra vegetables beans or lentils in your casseroles and stews reducing the volume of meat.
- Try to have salad, vegetables and/or fruit with every meal.
- Stock up on frozen vegetables for easy cooking in the microwave or oven.
- Keep cupboard stores of canned and frozen fruit choosing fruit canned in natural fruit juice instead of syrup.
- Add chopped, fresh or dried fruit onto your breakfast cereal.
- Limit the intake of dried fruits; they are good source of vitamins and minerals but very high in sugar and calories.
- Try some fruit desserts like unsweetened fruit crumbles or sugar free jelly with added chopped fruit.
- Aim for 1/3 of your lunch and 1/3 of your dinner plate to consist of vegetables or salad.
- If you feel you are not getting a nutritionally balanced diet, speak to a doctor or dietitian about taking one multivitamin and mineral supplement per day and ensure not to exceed your upper limit.