

Overview of Minerals and Vitamins

Tasawar Iqbal^{1*}, Sidra Altaf², Muhammad Faisal³, Farooq Wazeer Khan Niazi⁴, Ali Ahmad⁵

1. Institute of Physiology and Pharmacology, University of Agriculture Faisalabad, Pakistan.
2. Department of Pharmacy, University of Agriculture Faisalabad, Pakistan.
3. Department of Botany, Faculty of Sciences, University of Agriculture, Faisalabad, Pakistan.
4. Faculty of Science, Department of Zoology Wildlife and Fisheries, University of Agriculture Faisalabad, Pakistan.
5. Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan.

*Corresponding Author: tasawariqbal177@gmail.com

ABSTRACT

Vitamins and minerals are key for maintaining good health and bodily functions. Vitamins are important for metabolism and are classified into two groups based on solubility: water-soluble vitamins (such as vitamin C and B-complex) and fat-soluble vitamins (including vitamin A, D, E, and K)

Introduction

Minerals and Vitamins

Minerals and vitamins are essential micronutrients for bodily functions and overall wellness.

Minerals: These substances are found in soil and water and classified as inorganic compounds. As our bodies do not produce minerals, we must obtain them from our diet. Minerals are essential in various physiological processes, including bone health, nerve impulse propagation, fluid balance, and catalytic reactions. In nutrition, minerals are classified into two main categories: macrominerals, required in large quantities, and trace minerals, needed in smaller quantities.

Vitamins: Vitamins are essential for important body processes, although only needed in small amounts. Minerals have limited sources, while vitamins can come from plants and animals. Vitamins enhance the immune system, boost energy metabolism, and enhance the health of the skin and eyes. Vitamins can be grouped into two types based on their solubility: fat-soluble vitamins (A, D, E, and K) and water-soluble vitamins (C and B vitamins).

I. Minerals

Sr.No	Macrominerals	Sources	microminerals	Sources
1	Calcium	Dairy products (e.g., milk, cheese, yogurt), leafy green vegetables, fortified foods, and nuts	Iron	Red meat, poultry, fish, beans, lentils, and fortified cereals are good sources of iron
2	Magnesium	Nuts, seeds, whole grains, leafy green vegetables, and legumes	Zinc	Oysters, red meat, poultry, and whole grains are rich in zinc
3	Potassium	Bananas, potatoes, oranges, spinach, and beans are good sources of potassium	Selenium	Brazil nuts, fish, poultry, and whole grains are good sources of selenium
4	Sodium	Table salt (sodium chloride), processed foods, and naturally occurring sodium in some foods like celery and beets	Copper	Seafood, organ meats, nuts, seeds, and whole grains contain copper
5	Phosphorus	Dairy products, meat, fish, poultry, nuts, and whole grains are rich in phosphorus	Iodine	Iodized salt, fish, dairy products, and seaweed are sources of iodine
6	Chloride	Table salt is the primary dietary source of chloride, but it is also found in some foods like seaweed and celery.	Manganese	Whole grains, nuts, leafy green vegetables, and tea contain manganese
7			Fluoride	Fluoridated water, toothpaste, and some seafood contain fluoride
8			Molybdenum	Legumes, grains, leafy green vegetables, and organ meats are dietary sources of molybdenum

A. Macrominerals

Macrominerals are crucial minerals that demand a greater intake compared to trace minerals in the body. Having an adequate amount of these minerals is essential for maintaining optimal health as they play a critical role in various bodily functions. Excessive sodium intake may cause high blood pressure in

some individuals. Phosphorus is essential for bone and teeth formation, energy metabolism (specifically ATP production), and DNA and RNA synthesis. Additionally, it helps maintain acid-base balance. Chloride, a compound in table salt, maintains fluid balance in the body. It helps synthesize gastric acid, aiding digestion.

B. Trace Minerals (microminerals)

Trace minerals are imperative minerals needed by the body in smaller quantities in comparison to macrominerals. Despite their low dietary requirement, these minerals play vital roles in biochemical and physiological processes. Furthermore, it has a crucial function in upkeeping the well-being of bones and the functionality of the nervous system. Thyroid hormones, vital for metabolism control and facilitating the growth of the brain and nervous system, rely on the presence of iodine. Manganese plays a vital role in the development of bones, promoting blood clotting, and providing antioxidant properties. Furthermore, this specific enzyme plays a crucial part in the process of breaking down carbohydrates.

II. Vitamins

Sr.No	Fat-Soluble Vitamins	Sources	Water-Soluble Vitamins	Sources
1	Vitamin A	Found in animal products like liver, fish, and dairy. found in colorful fruits and vegetables like carrots, sweet potatoes, and spinach	Vitamin C	Citrus fruits (oranges, lemons), strawberries, kiwi, broccoli, bell peppers, and tomatoes
2	Vitamin D	skin is exposed to sunlight (UV-B radiation). Dietary sources include fatty fish (e.g., salmon, mackerel), fortified dairy products, and supplements	Vitamin B1	Whole grains, pork, beans, and nuts
3	Vitamin D3	Egg yolks, and fortified foods like milk and cereals, sunlight, fatty fish (salmon, mackerel)	Vitamin B2	Dairy products, lean meats, green leafy vegetables, and enriched cereals
4	Vitamin E	Nuts, seeds, vegetable oils (sunflower oil, almond oil), spinach, and broccoli	Vitamin B3	Meat, poultry, fish, nuts, and whole grains
5	Vitamin K	Leafy green vegetables (kale, spinach), broccoli, Brussels sprouts, and certain vegetable oils (soybean oil)	Vitamin B5	Meat, poultry, fish, whole grains, and legumes
6			Vitamin B6	Meat, fish, poultry, bananas, potatoes, and chickpeas
7			Vitamin B7	egg yolks, nuts, whole grains,
8			Vitamin B9	Leafy green vegetables, legumes, citrus fruits
9			Vitamin B12	Meat, fish, poultry, dairy products

A. Fat-Soluble Vitamins

Fat-soluble vitamins refer to vitamins that can blend with dietary fats and are taken in by the small intestine alongside fats. Adipose tissues and the liver serve as storage sites for lipids, enabling long-term retention. Vitamin A is essential for maintaining clear eyesight, particularly in dimly lit environments. It is essential to ensure the proper functioning of the immune system, the health of the skin, the growth of tissues, and the development of bones. Additionally, this nutrient bolsters immune system support and maintains optimal skin wellness.

B. Water-Soluble Vitamins

Water-soluble vitamins dissolve in water and have high bioavailability in the body. Water-soluble vitamins are not stored in the body like fat-soluble vitamins. Instead, any excess is removed through urination. Vitamin C protects cells from oxidative harm. Collagen is crucial for skin integrity, connective tissues, and wound healing. Vitamin C fortifies the immune system and aids in absorbing plant-based iron. Thiamine is vital for energy

<https://biologicaltimes.com/>

metabolism, especially in carbohydrate breakdown. Furthermore, it is significant in regulating and facilitating nerve functionality. Riboflavin is essential for energy production and fat and drug metabolism. It is important for skin and eye health. Niacin is vital for energy metabolism, DNA repair, and fatty acid synthesis. Additionally, it plays a vital role in maintaining strong skin integrity and efficient nerve pathways. Pantothenic acid is essential for energy metabolism and biosynthesis of fatty acids and cholesterol. This element is found in every cell in the human body. Pyridoxine is vital for amino acid metabolism, neurotransmitter synthesis, and red blood cell production. Additionally, it plays a vital role in immune function regulation and enhancement. Biotin is crucial for fatty acid synthesis, glucose metabolism, and maintaining healthy hair, skin, and nails. Folate is crucial for DNA synthesis and cell division. Preventing neural tube defects in fetuses is crucial during pregnancy. Vitamin B12 is crucial for red blood cell production, nerve conductance, and metabolism of fatty acids and amino acids. Unlike other B vitamins, this vitamin is mainly derived from animals [1].

III. Functions of Minerals and Vitamins

A. Roles in the Body

Minerals and vitamins are vital for the body, supporting many processes

Sr. No	Minerals	Role	Functions
1	Calcium	Builds and maintains strong bones and teeth	Blood clotting, muscle contraction, nerve transmission
2	Magnesium	Supports muscle and nerve function	Bone health, energy production, DNA and protein synthesis
3	Potassium	Maintains proper fluid balance	Supports muscle contractions (including the heart), nerve function.
4	Sodium	Helps regulate fluid balance	Nerve function, muscle contractions
5	Phosphorus	Important for bone and teeth health.	Energy production, DNA synthesis, acid-base balance
6	Chloride	Maintains fluid balance	Supports digestion by aiding in stomach acid production

Vitamins role in body

Sr. No	Vitamins	Scientific name	Role	Function
1	Vitamin A	Retinol	Maintains healthy vision, especially in low-light conditions	Supports immune function, skin health, and tissue growth
2	Vitamin D	Calciferol	Facilitates calcium absorption for bone health	Supports immune function
3	Vitamin E	Tocopherol	Acts as an antioxidant, protecting cells from oxidative damage	Supports immune function and skin health
4	Vitamin K	Phylloquinone or Menadione	Essential for blood clotting	Supports bone health
5	Vitamin C	Ascorbic Acid	Antioxidant	Supports immune system and collagen production
6	Vitamin B1	Thiamine	Energy metabolism	Converts food into energy
7	Vitamin B2	Riboflavin	Energy production	Helps release energy from carbohydrates
8	Vitamin B3	Niacin	Metabolism	Supports cellular energy production
9	Vitamin B5	Pantothenic Acid	Metabolic processes	Involved in fatty acid synthesis
10	Vitamin B6	Pyridoxine	Amino acid metabolism	Supports protein synthesis
11	Vitamin B7	Biotin	Metabolism	Essential for fatty acid synthesis
12	Vitamin B9	Folate	DNA synthesis	Important for cell division and growth
13	Vitamin B12	Cobalamin	Nervous system function	Maintains nerve cells and supports red blood cell formation
14	Vitamin B5	Choline	Cellular structure	Part of cell membranes and neurotransmitter synthesis

B. Health Benefits

The functions of minerals and vitamins in the body contribute to several health benefits

Minerals

Calcium is important for healthy bones, teeth, preventing osteoporosis, blood clotting, and muscle function. Magnesium reduces cramps, improves nerves, and boosts heart health. Potassium regulates blood pressure, reduces stroke risk, and improves muscle and nerve function. Sodium is vital for fluid balance and proper nerve and muscle function. Phosphorus supports bones, teeth, energy, and DNA synthesis. Chloride is necessary for fluid balance and digestion.

Vitamins

Vitamin A improves eyesight, reduces night blindness, boosts the immune system, and promotes healthy skin. Vitamin D promotes strong bones, teeth, and immune system, while lowering the risk of rickets and osteoporosis.

Vitamin E provides antioxidant defense, reduces disease risk due to oxidative stress, and boosts skin health. Vitamin K promotes blood clotting, reduces bleeding, and supports bone health.

A. Deficiency Symptoms

Nutrient deficiencies occur when the body lacks essential vitamins or minerals. These deficiencies can cause health issues and symptoms that vary based on the specific lacking nutrient [4].

Some common vitamin deficiencies signs and symptoms of water-soluble vitamin

Sr.No	Water-Soluble Vitamin	Deficiency Signs and Symptoms
1	Vitamin C (Ascorbic Acid)	Scurvy: Bleeding gums, weakness, anemia
2	Vitamin B1 (Thiamine)	Beriberi: Muscle weakness, heart problems
3	Vitamin B2 (Riboflavin)	Dermatitis, sore throat, redness and swelling of the lining of the mouth and throat
4	Vitamin B3 (Niacin)	Pellagra: Skin rash, diarrhea, mental confusion
5	Vitamin B6 (Pyridoxine)	Anemia, neurological symptoms
6	Vitamin B7 (Biotin)	Hair loss, skin rashes, neurological symptoms
7	Vitamin B9 (Folate)	Anemia, birth defects in pregnancy
8	Vitamin B12 (Cobalamin)	Pernicious anemia, nerve damage
9	Vitamin B5 (Pantothenic Acid)	Rare; may include fatigue and numbness
10	Vitamin B5 (Choline)	Not well-defined; potential liver and muscle damage

Sr.No	Fat-Soluble Vitamin	Deficiency Signs and Symptoms
1	Vitamin A (Retinol)	Night blindness, Dry, scaly skin, Impaired immune function, Vision problems
2	Vitamin D (Calciferol)	Rickets (in children): Soft, deformed bones. Osteomalacia (in adults): Weakened bones, bone pain, Increased risk of fractures, Muscle weakness
3	Vitamin E (Tocopherol)	Nerve and muscle damage, Vision problems, Impaired immune function, Anemia, Numbness and tingling in extremities
4	Vitamin K (Phylloquinone or Menadione)	Impaired blood clotting, Increased bleeding and bruising Hemorrhages, Gastrointestinal bleeding, Blood in the urine or stool

The deficiency signs and symptoms associated with fat-soluble vitamins

Mineral deficiencies and their associated signs and symptoms

Sr.No	Mineral	Deficiency Signs and Symptoms
1	Iron	Anemia, Brittle nails, Headache, Shortness of breath
2	Calcium	Osteoporosis, Muscle cramps, Dental problems
3	Magnesium	Muscle cramps, heartbeat, Weakness
4	Potassium	Muscle weakness and cramps, Constipation, Numbness and tingling
5	Sodium	Muscle cramps, Hyponatremia
6	Iodine	Thyroid problems, Weight gain, Dry skin, Hair loss
7	Zinc	Growth retardation (in children), Delayed wound healing, Impaired immune function, Skin problems
8	Selenium	Hair loss, Muscle pain, Thyroid problems
9	Potassium	Muscle weakness and cramps, Irregular heartbeat
10	Copper	Anemia, Osteoporosis, Neurological symptoms
11	Fluoride	Dental cavities, Tooth decay
12	Manganese	Bone and joint problems, Impaired glucose metabolism, Skin problems, Neurological symptoms
13	Chromium	Glucose intolerance, Weight loss, Poor skin health

B. Toxicity Symptoms

Excessive intake of vitamins and minerals can harm health. Symptoms of toxicity vary by nutrient [2].

Vitamin toxicity (hypervitaminosis) signs and symptoms for water-soluble

Sr.No	Water-Soluble vitamins	Toxicity Signs and Symptoms
1	Vitamin C	Diarrhea, Nausea, Abdominal cramps, Kidney stones
2	Vitamin B3 (Niacin)	Flushing of the skin, Nausea, Vomiting, Liver damage
3	Vitamin B6 (Pyridoxine)	Nerve damage, Sensory neuropathy, Skin lesions
4	Vitamin B9 (Folate)	High doses may mask vitamin B12 deficiency, leading to neurological problems
5	Vitamin B3 (Biotin)	Not well-defined: excessive intake is rare

Mineral toxicity signs and symptoms for various minerals

Mineral toxicity can result from excessive intake or exposure to minerals, especially through supplements or the environment [3].

Conclusion

Vitamins and minerals are vital for overall health and a balanced diet. Understanding roles, origins, and negative effects of deficiencies or toxicities is crucial for informed dietary decisions. A balanced diet is usually enough to meet micronutrient needs. In some cases, additional supplements may be necessary. Finding the right balance is key to avoiding health issues caused by nutrient imbalances. Healthcare providers help individuals find dietary plans that suit their needs. By appreciating vitamins and minerals, we can enhance our health and well-being for life.

References:

[1] Iqbal T, Altaf S. Treatment of Male Infertility Disorders via Tribulus Terrestris and Multivitamins.
 [2] Iqbal T, Altaf S, Ahmad A, Riaz H, Zulfiqar MW. Multivitamins and Minerals are used for the Treatment of Hair Loss.

- [3] Iqbal T, Altaf S, Saleem M. Phytochemicals used in the treatment of COVID-19 Infection.
[4] Soni MG, Thurmond TS, Miller III ER, Spriggs T, Bendich A, Omaye ST. Safety of vitamins and minerals: controversies and perspective. *Toxicological sciences*. 2010 Dec 1;118(2):348-55.

