1. Iron deficiency

Iron is an essential mineral.

It’s a large component of red blood cells, in which it binds with hemoglobin and transports oxygen to your cells. The two types of dietary iron are:

Heme iron. This type of iron is very well absorbed. It’s only found in animal foods, with [red meat](https://www.healthline.com/nutrition/is-red-meat-bad-for-you-or-good) containing particularly high amounts.

Non-heme iron. This type, found in both animal and plant foods, is more common. It is not absorbed as easily as heme iron.

[Iron deficiency](https://www.healthline.com/nutrition/iron-deficiency-signs-symptoms) is one of the most common nutrient deficiencies in the world, affecting more than 25% of people worldwide ([1Trusted Source,](https://www.who.int/nutrition/publications/micronutrients/anaemia_iron_deficiency/9789241596107/en/) [2Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/18498676)).

This number rises to 47% in preschool children. Unless they’re given iron-rich or iron-fortified foods, they are very likely to lack iron.

Around 30% of menstruating women may be deficient as well due to monthly blood loss, and up to 42% of young, pregnant women may be deficient as well.

Additionally, vegetarians and [vegans have an increased risk of deficiency](https://www.healthline.com/nutrition/7-supplements-for-vegans) because they consume only non-heme iron, which is not absorbed as well as heme iron ([3Trusted Source,](https://www.ncbi.nlm.nih.gov/pubmed/14988640) [4Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/1581009)).

The most common consequence of iron deficiency is anemia, in which the number of your red blood cells and your blood’s ability to carry oxygen drops.

Symptoms usually include tiredness, weakness, a weakened immune system, and impaired brain function ([5Trusted Source,](https://www.ncbi.nlm.nih.gov/pubmed/18390780) [6Trusted Source](http://onlinelibrary.wiley.com/doi/10.1111/j.1467-3010.2005.00467.x/abstract)).

The best dietary sources of heme iron include ([7Trusted Source](https://fdc.nal.usda.gov/index.html)):

Red meat. 3 ounces (85 grams) of ground beef provide almost 30% of the Daily Value (DV). Organ meat. One slice (81 grams) of liver gives more than 50% of the DV.

Shellfish. Clams, mussels, and oysters are excellent sources of heme iron, with 3 ounces (85 grams) of cooked oysters packing roughly 50% of the DV.

Canned sardines. One 3.75-ounce (106-gram) can offer 34% of the DV. The best dietary sources of non-heme iron include:

Beans. Half a cup (85 grams) of cooked kidney beans provides 33% of the DV.

Seeds. Pumpkin, sesame, and squash seeds are good sources of non-heme iron. One ounce (28 grams) of roasted pumpkin or squash seeds contains 11% of the DV.

Dark, leafy greens. Broccoli, kale, and spinach are rich in iron. One ounce (28 grams) of fresh [kale](https://www.healthline.com/nutrition/10-proven-benefits-of-kale) provides 5.5% of the DV.

However, you should never supplement with iron unless you truly need it. [Too much iron](https://www.healthline.com/nutrition/why-too-much-iron-is-harmful) can be very harmful. Notably, vitamin C can enhance the absorption of iron. Eating vitamin-C-rich foods like oranges, kale, and bell peppers alongside iron-rich foods can help maximize your iron absorption.

SUMMARY

Iron deficiency is very common, especially among young women, children, and vegetarians. It may cause anemia, fatigue, a weakened immune system, and impaired brain function.

1. Iodine deficiency

Iodine is an essential mineral for normal thyroid function and the production of thyroid hormones ([8Trusted](https://www.ncbi.nlm.nih.gov/pubmed/21748117/) [Source](https://www.ncbi.nlm.nih.gov/pubmed/21748117/)).

Thyroid hormones are involved in many bodily processes, such as growth, brain development, and bone maintenance. They also regulate your metabolic rate.

Iodine deficiency is one of the most common nutrient deficiencies, affecting nearly a third of the world’s population ([9Trusted Source,](https://www.ncbi.nlm.nih.gov/pubmed/23472655) [10Trusted Source,](https://www.ncbi.nlm.nih.gov/pubmed/12848208) [11Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/22892867)).

The most common symptom of [iodine deficiency](https://www.healthline.com/nutrition/iodine-deficiency-symptoms) is an enlarged thyroid gland, also known as a goiter. It may also cause an increase in heart rate, shortness of breath, and weight gain ([8Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/21748117/)).

Severe iodine deficiency is linked to serious harm, especially in children. It may cause mental retardation and developmental abnormalities ([8Trusted Source,](https://www.ncbi.nlm.nih.gov/pubmed/21748117/) [10Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/12848208)).

Good [dietary sources of iodine](https://www.healthline.com/nutrition/iodine-rich-foods) include ([7Trusted Source](https://fdc.nal.usda.gov/index.html)): Seaweed. Only 1 gram of kelp packs 460–1,000% of the DV.

Fish. Three ounces (85 grams) of baked cod provide 66% of the DV.

Dairy. One cup (245 grams) of plain yogurt offers about 50% of the DV. Eggs: One large egg contains 16% of the DV.

However, these amounts can vary greatly. As iodine is found mostly in soil and ocean water, iodine-poor soil will result in low-iodine food.

Some countries mandate the enrichment of table salt with iodine, which has successfully reduced the incidence of deficiencies ([12Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/23201844/)).

SUMMARY

Iodine is one of the most common nutrient deficiencies in the world. It may cause enlargement of the thyroid gland. Severe iodine deficiency can cause mental retardation and developmental abnormalities in children.

1. Vitamin D deficiency

[Vitamin D](https://www.healthline.com/nutrition/vitamin-d-101) is a fat-soluble vitamin that functions like a steroid hormone in your body.

It travels through your bloodstream and into cells, telling them to turn genes on or off. Almost every cell in your body has a receptor for vitamin D.

Vitamin D is produced from cholesterol in your skin upon exposure to sunlight. Thus, people who live far from the equator are likely to be deficient unless their dietary intake is adequate or they supplement with vitamin D ([13Trusted Source,](https://www.ncbi.nlm.nih.gov/pubmed/20980651) [14Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/12520530)).

In the United States, about 42% of people may be deficient in this vitamin. This number rises to 74% in older adults and 82% in people with dark skin since their skin produces less vitamin D in response to sunlight

([15Trusted Source,](https://www.ncbi.nlm.nih.gov/pubmed/25665158) [16Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/17608242)).

[Vitamin D deficiency](https://www.healthline.com/nutrition/vitamin-d-deficiency-symptoms) is not usually obvious, as its symptoms are subtle and may develop over years or decades ([17Trusted Source,](https://www.ncbi.nlm.nih.gov/pubmed/18400738) [18Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/26185598)).

Adults who are deficient in vitamin D may experience muscle weakness, bone loss, and an increased risk of fractures. In children, it may cause growth delays and soft bones (rickets) ([17Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/18400738), [20Trusted](https://www.ncbi.nlm.nih.gov/pubmed/18844844) [Source,](https://www.ncbi.nlm.nih.gov/pubmed/18844844) [21Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/22114830)).

Also, vitamin D deficiency may play a role in reduced immune function and an increased risk of cancer ([22](http://chp.sagepub.com/content/16/1/58.abstract)).

While very few foods contain significant amounts of this vitamin, the best dietary sources are ([23Trusted Source](https://ods.od.nih.gov/factsheets/VitaminD-HealthProfessional/)): Cod liver oil. A single tablespoon (15 ml) packs 227% of the DV.

Fatty fish. Salmon, mackerel, sardines, and trout are rich in vitamin D. A small, 3-ounce (85-gram) serving of cooked salmon provides 75% of the DV.

Egg yolks. One large egg yolk contains 7% of the DV.

People who are deficient may want to take a supplement or increase their sun exposure. It is hard to get [sufficient amounts](https://www.healthline.com/nutrition/how-much-vitamin-d-to-take) through diet alone.

SUMMARY

Vitamin D deficiency is very common. Symptoms include muscle weakness, bone loss, an increased risk of fractures, and — in children — soft bones. It is very difficult to get sufficient amounts from your diet alone.

1. Vitamin B12 deficiency

Vitamin B12, also known as cobalamin, is a water-soluble vitamin.

It is essential for blood formation, as well as brain and nerve function.

Every cell in your body needs B12 to function normally, but your body is unable to produce it. Therefore, you must get it from food or supplements.

B12 is only found in sufficient amounts in animal foods, although certain types of seaweed may provide small quantities. Therefore, people who do not eat animal products are at an increased risk of deficiency.

Studies indicate that up to 80–90% of [vegetarians and vegans](https://www.healthline.com/nutrition/vegetarian-and-vegan-mistakes) may be deficient in vitamin B12 ([24Trusted](https://www.ncbi.nlm.nih.gov/pubmed/23356638) [Source,](https://www.ncbi.nlm.nih.gov/pubmed/23356638) [25Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/24667752)).

More than 20% of older adults may also be deficient in this vitamin since absorption decreases with age ([26Trusted Source,](https://www.ncbi.nlm.nih.gov/pubmed/23193625/) [27Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/15289425), [28Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/18411381/)).

B12 absorption is more complex than that of other vitamins because it’s aided by a protein known as intrinsic

factor. Some people are lacking in this protein and may thus need B12 injections or higher doses of supplements.

One common symptom of [vitamin B12 deficiency](https://www.healthline.com/nutrition/vitamin-b12-deficiency-symptoms) is megaloblastic anemia, which is a blood disorder that enlarges your red blood cells.

Other symptoms include impaired brain function and elevated homocysteine levels, which is a risk factor for several diseases ([29Trusted Source,](https://www.ncbi.nlm.nih.gov/pubmed/21671542) [30Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/12643357)).

Dietary sources of vitamin B12 include ([7Trusted Source](https://fdc.nal.usda.gov/index.html)):

Shellfish. Clams and oysters are rich in vitamin B12. A 3-ounce (85-gram) portion of cooked clams provides 1,400% of the DV.

Organ meat. One 2-ounce (60-gram) slice of liver packs more than 1,000% of the DV. Meat. A small, 6-ounce (170-gram) beef steak offers 150% the DV.

Eggs. One whole egg provides about 6% of the DV.

Milk products. One cup (240 ml) of whole milk contains about 18% of the DV.

Vitamin B12 isn’t considered harmful in large amounts because it’s often poorly absorbed and easily excreted. SUMMARY

Vitamin B12 deficiency is very common, especially in vegetarians, vegans, and older adults. The most common symptoms include blood disorders, impaired brain function, and elevated homocysteine levels.

1. Calcium deficiency

Calcium is essential for every cell in your body. It mineralizes bones and teeth, especially during times of rapid growth. It is also very important for bone maintenance.

Additionally, calcium serves as a signaling molecule. Without it, your heart, muscles, and nerves would not be able to function.

The calcium concentration in your blood is tightly regulated, and any excess is stored in bones. If your intake is lacking, your bones will release calcium.

That is why the most common symptom of calcium deficiency is osteoporosis, characterized by softer and more fragile bones.

One survey in the United States found that fewer than 15% of teenage girls, fewer than 10% of women over 50, and fewer than 22% of teenage boys and men over 50 met the recommended calcium intake ([31Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/20181782/)). Although supplementing increased these numbers slightly, most people were still not getting enough calcium.

Symptoms of more severe dietary calcium deficiency include soft bones (rickets) in children and osteoporosis, especially in older adults ([32Trusted Source,](https://www.ncbi.nlm.nih.gov/pubmed/22893720) [33Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/12486449)).

Dietary [sources of calcium](https://www.healthline.com/nutrition/15-calcium-rich-foods) include ([7Trusted Source](https://fdc.nal.usda.gov/index.html)):

Boned fish. One can (92 grams) of sardines contains 44% of the DV. Dairy products. One cup (240 ml) of milk provides 35% of the DV.

Dark green vegetables. Kale, spinach, bok choy, and broccoli are rich in calcium. Just 1 ounce (28 grams) of fresh kale offers 5.6% of the DV.

The effectiveness and safety of [calcium supplements](https://www.healthline.com/nutrition/calcium-supplements) have been somewhat debated in the last few years. Some studies demonstrate an increased risk of heart disease in people taking calcium supplements, although other studies have found no effects ([34Trusted Source,](https://www.ncbi.nlm.nih.gov/pubmed/18198394/) [35Trusted Source,](https://www.ncbi.nlm.nih.gov/pubmed/24803331/) [36Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/25252963)).

While it’s best to get calcium from food rather than supplements, these supplements seem to benefit people who are not getting enough in their diet ([37Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/25827454)).

SUMMARY

Low calcium intake is very common, especially in women of all ages and older adults. The main symptom of calcium deficiency is an increased risk of osteoporosis later in life.

1. Vitamin A deficiency

Vitamin A is an essential fat-soluble vitamin. It helps form and maintain healthy skin, teeth, bones, and cell membranes. Furthermore, it produces eye pigments, which are necessary for vision ([38](https://www.nlm.nih.gov/medlineplus/ency/article/002400.htm)).

There are two different types of dietary [vitamin A](https://www.healthline.com/nutrition/vitamin-a) ([7Trusted Source](https://fdc.nal.usda.gov/index.html)):

Preformed vitamin A. This type of vitamin A is found in animal products like meat, fish, poultry, and dairy.

Pro-vitamin A. This type is found in plant-based foods like fruits and vegetables. Beta carotene, which your body turns into vitamin A, is the most common form.

More than 75% of people who eat a Western diet get more than enough vitamin A and do not need to worry about deficiency ([39Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/12221269)).

However, vitamin A deficiency is very common in many developing countries. About 44–50% of preschool-aged children in certain regions have vitamin A deficiency. This number is around 30% in Indian women ([40Trusted](https://www.ncbi.nlm.nih.gov/pubmed/17016949) [Source,](https://www.ncbi.nlm.nih.gov/pubmed/17016949) [41Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/24592582/)).

Vitamin A deficiency can cause both temporary and permanent eye damage and may even lead to blindness. In fact, this deficiency is the world’s leading cause of blindness.

Vitamin A deficiency can also suppress immune function and increase mortality, especially among children and pregnant or breastfeeding women ([40Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/17016949)).

[Dietary sources](https://www.healthline.com/nutrition/foods-high-in-vitamin-a) of preformed vitamin A include ([7Trusted Source](https://fdc.nal.usda.gov/index.html)):

Organ meat. One 2-ounce (60-gram) slice of beef liver provides more than 800% of the DV. Fish liver oil. One tablespoon (15 ml) packs roughly 500% of the DV.

Dietary sources of beta carotene (pro-vitamin A) include:

Sweet potatoes. One medium, 6-ounce (170-gram) boiled sweet potato contains 150% of the DV. Carrots. One large carrot provides 75% of the DV.

Dark green, leafy vegetables. One ounce (28 grams) of fresh spinach provides 18% of the DV.

While it is very important to consume enough of this vitamin, too much preformed vitamin A may cause toxicity. This does not apply to pro-vitamin A, such as beta carotene. High intake may cause your skin to turn slightly orange, but this effect isn’t dangerous.

SUMMARY

Vitamin A deficiency is very common in many developing countries. It may cause eye damage and blindness, as well as suppress immune function and increase mortality among women and children.

1. Magnesium deficiency

Magnesium is a key mineral in your body.

Essential for bone and teeth structure, it’s also involved in more than 300 enzyme reactions ([42Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/25839058)).

Close to 70% of the US population under 71, and about 80% over 71 years old consume less than the required amount of magnesium. ([43Trusted Source](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6032400/)).

Low intake and blood levels of magnesium are associated with several conditions, including type 2 diabetes, metabolic syndrome, heart disease, and osteoporosis ([44Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/20536778)).

Low levels are particularly common among hospitalized patients. Some studies find that 9–65% of them are deficient ([45Trusted Source,](https://www.ncbi.nlm.nih.gov/pubmed/26069819) [46Trusted Source,](https://www.ncbi.nlm.nih.gov/pubmed/6829504/) [47Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/2914492/)).

Deficiency may be caused by disease, drug use, reduced digestive function, or inadequate magnesium intake ([48Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/1591145)).

The main symptoms of severe [magnesium deficiency](https://www.healthline.com/nutrition/magnesium-deficiency-symptoms) include abnormal heart rhythm, muscle cramps, restless leg syndrome, fatigue, and migraines ([49Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/9703590), [50Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/12011773), [51Trusted Source](https://www.ncbi.nlm.nih.gov/pubmed/8792038)).

More subtle, long-term symptoms that you may not notice include insulin resistance and high blood pressure. Dietary [sources of magnesium](https://www.healthline.com/nutrition/10-foods-high-in-magnesium) include ([7Trusted Source](https://fdc.nal.usda.gov/index.html)):

Whole grains. One cup (170 grams) of oats contains 74% of the DV. Nuts. Twenty almonds pack 17% of the DV.

Dark chocolate. One ounce (30 grams) of dark chocolate offers 15% of the DV.

Dark green, leafy vegetables. One ounce (30 grams) of raw spinach provides 6% of the DV. SUMMARY

Magnesium deficiency is common in Western countries, and low intake is associated with many health conditions and diseases.

Comprehensive Guide to Nutritional Deficiencies and Required Nutrients Vitamin A Deficiency

Required Nutrient: Vitamin A (Retinol)

Symptoms: Night blindness, dry eyes, increased susceptibility to infections, dry skin, and delayed growth. Functions: Supports vision, immune function, reproduction, and cellular communication. It also plays a critical role in the normal formation and maintenance of the heart, lungs, kidneys, and other organs.

Common Food Sources: Carrots, sweet potatoes, spinach, kale, eggs, and liver.

Recommended Daily Intake (RDI): 900 mcg/day for men, 700 mcg/day for women.

Vitamin C Deficiency

Required Nutrient: Vitamin C (Ascorbic Acid)

Symptoms: Scurvy, fatigue, swollen gums, joint pain, and poor wound healing.

Functions: Acts as an antioxidant, aids in collagen synthesis, helps in the absorption of iron from plant-based foods, and supports the immune system.

Common Food Sources: Citrus fruits, strawberries, bell peppers, broccoli, Brussels sprouts. Recommended Daily Intake (RDI): 90 mg/day for men, 75 mg/day for women.

Iron Deficiency

Required Nutrient: Iron

Symptoms: Anemia, fatigue, dizziness, pale skin, shortness of breath, and cold hands and feet.

Functions: Essential for the production of hemoglobin, a protein in red blood cells that carries oxygen from the lungs to the rest of the body.

Common Food Sources: Red meat, poultry, fish, lentils, beans, tofu, and fortified cereals. Recommended Daily Intake (RDI): 8 mg/day for men, 18 mg/day for women.

Calcium Deficiency

Required Nutrient: Calcium

Symptoms: Osteoporosis, brittle nails, muscle cramps, numbness in fingers, and poor bone growth.

Functions: Vital for building and maintaining strong bones and teeth, muscle contraction, nerve signaling, and blood clotting.

Common Food Sources: Dairy products, leafy greens, fortified plant-based milks, almonds, and sardines. Recommended Daily Intake (RDI): 1,000 mg/day for most adults.

Vitamin D Deficiency

Required Nutrient: Vitamin D

Symptoms: Rickets in children, osteomalacia in adults, bone pain, muscle weakness, and increased risk of cardiovascular disease.

Functions: Helps the body absorb calcium and phosphorus, promotes bone growth and remodeling, and supports immune function.

Common Food Sources: Sunlight exposure, fatty fish, fortified milk, egg yolks, and mushrooms. Recommended Daily Intake (RDI): 600 IU/day for most adults.

Vitamin Deficiency Diseases

Vitamin is a micronutrient that is not prepared by the body in sufficient amounts. This is the reason why it is necessary to take in from outside sources for the normal functioning of the body. Inadequate intake of vitamins results in vitamin deficiency diseases.

Following is the list of some of the vitamins and the deficiency diseases caused by them: Vitamin A

It is an important micronutrient that is obtained from different food sources such as carrots, spinach, milk, egg, liver and fish. It is required for normal vision, reproduction, growth and healthy immune system of an individual.

Most children below five years of age suffer from xerophthalmia, a serious eye disorder, in which the child is at risk of becoming blind. Vitamin A deficiency in a pregnant woman can lead to complications during pregnancy and childbirth.

Vitamin B

Vitamin B can be of different types, such as Vitamin B1, B2, B12 etc. The deficiency diseases depend on the type of Vitamin B that a person is lacking.

Vitamin B1: Deficiency of vitamin B1 causes [beriberi,](https://byjus.com/biology/beriberi/) which results in weak muscles and severe weight loss. Acute deficiency can lead to paralysis and cardiac failure.

Vitamin B6: Lack of vitamin B6 causes deficiency diseases such as anaemia and certain skin disorders such as cracks around the mouth. It can also lead to depression and nervous breakdowns.

Vitamin B12: Lack of vitamin B12 causes pernicious anaemia. Other diseases related to B12 deficiency are muscle and nerve paralysis, extreme fatigue, dementia and depression.

Vitamin C

Deficiency of vitamin C can cause scurvy, a disease that is characterised by bleeding gums, skin spots and swelling in joints. It also affects the immune system and can even be fatal in acute conditions.

Also Read: [Scurvy](https://byjus.com/biology/scurvy/) Vitamin D

Vitamin D deficiency causes rickets, which leads to the weakening of bones, especially near the joints. It can also lead to the decay of teeth.

Vitamin K

Vitamin K is important for blood coagulation. Its deficiency is common in infants and leads to excessive bleeding due to the inability to form blood clots.

Also Read: [Food Deficiency](https://byjus.com/biology/food-deficiency/)

Mineral Deficiency Diseases

Minerals are inorganic [nutrients](https://byjus.com/biology/nutrients/) that include trace elements such as copper, zinc, iodine, and iron, along with the micronutrients such as calcium, potassium, magnesium and sodium.

Following is the list of a few minerals along with the deficiency diseases associated with them:

Iodine

Iodine is the most important element required for the brain development of the developing foetus. It is responsible for a number of other functions such as the production of hormones. Salt is an important source of iodine in many countries. The deficiency of iodine leads to goitre.

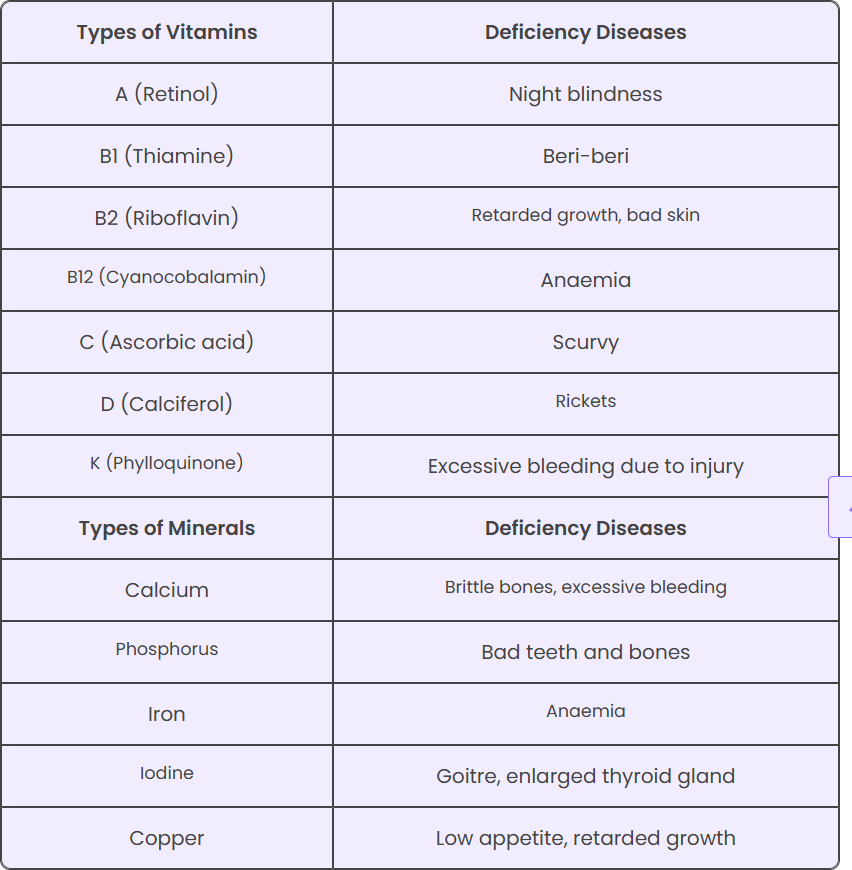
Iron

Iron, in the form of haemoglobin, carries oxygen from the lungs to different tissues of the body. Iron deficiency causes anaemia, a condition in which the blood is unable to carry the required oxygen to the tissues, which also results in death. Around 40-60% of infants in developing countries suffer from mental impairment due to iron deficiency. Red meat, spinach, poultry, etc. are some of the iron-rich foods.

# Prevention of Deficiency Diseases

The deficiency diseases can be prevented in the following manner:

* Eating simple, wholesome food such as groundnut, soybean, pulses, etc.
* Prolonged cooking and undercooked food lose their nutritional value. Keeping cut vegetables and fruits for a longer period also destroys their nutritional value. Avoiding this can prevent deficiency diseases.
* Fermentation and sprouting retain and increase the nutritional value of food.

Deficiency or Disease

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Nutri

ent

Definition/Cut-off Value



Any currently treated or untreated nutrient deficiency or disease. These include, but are not limited to, Protein Energy Malnutrition, Scurvy, Rickets, Beriberi, Hypocalcemia, Osteomalacia, Vitamin K Deficiency, Pellagra, Xerophthalmia, and Iron Deficiency.

Presence of condition diagnosed, documented, or reported by a physician or someone working under a physician’s orders, or as self-reported by applicant/participant/caregiver. See Clarification for more information about self-reporting a diagnosis.

Participant Category and Priority Level

|  |  |
| --- | --- |
| Category | Priority |
| Pregnant Women | I |

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|  |  |
| --- | --- |
| Breastfeeding Women | I |
| Non-Breastfeeding Women | III, IV, V, or VI |
| Infants | I |
| Children | III |

# Justification

Nutrient deficiencies or diseases can be the result of poor nutritional intake, chronic health conditions, acute health conditions, medications, altered nutrient metabolism, or a combination of these factors, and can impact the levels of both macronutrients and micronutrients in the body. They can lead to alterations in energy metabolism, immune function, cognitive function, bone formation, and/or muscle function, as well as growth and development if the deficiency is present during fetal development and early childhood.

The Centers for Disease Control and Prevention (CDC) estimates that less than 10% of the United States population has nutrient deficiencies; however, nutrient deficiencies vary by age, gender, and/or race and ethnicity (1). For certain segments of the population, nutrient deficiencies may be as high as one third of the population (1).

Intake patterns of individuals can lead to nutrient inadequacy or nutrient deficiencies among the general population. Intakes of nutrients that are routinely below the Dietary Reference Intakes (DRI) can lead to a decrease in how much of the nutrient is stored in the body and how much is available for biological functions. DRIs are based on age and sex and include Recommended Dietary Allowance (RDA), Adequate Intake (AI), Estimated Average Requirement (EAR) and Tolerable Upper Intake Level (UL). DRIs are established by the National Academies of Science, Engineering and Medicine and include the following definitions:

* + RDA - Indicates the average daily intake of particular nutrients to meet the requirements of 97- 98% of healthy people.
  + AI - Established to assume adequate intake when there is insufficient evidence to develop an RDA.

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* EAR - The average daily intake of a nutrient that is thought to meet the needs of 50% of healthy individuals. EARs are used to assess the adequacy of nutrient intakes among populations rather than the individual.
* UL - The highest nutrient intake that is considered to be safe and does not lead to adverse health effects in the general population (2).

Macronutrient deficiencies include deficiencies in protein, fat, and/or calories, and can lead to stunting, pronounced wasting (marasmus) or a disproportionately large abdomen (a sign of kwashiorkor). Marasmus is a disease of severe wasting due to a prolonged inadequate intake of protein, carbohydrate, and fat.

Kwashiorkor is a disease that results from a prolonged inadequate intake of protein. Essential fatty acid deficiencies, which would include omega-3 fatty acid deficiency, are thought to be rare among the general population (3, 4). Signs of an essential fatty acid deficiency may include a dry scaly rash, decreased growth in infants and children, lowered immune response, and impaired wound healing (3).

Micronutrient deficiencies would include deficiencies in vitamins and minerals in the body. According to National Health and Nutrition Examination Survey (NHANES) data, the most common nutrient deficiencies from 2003-2006 in the general United States population were vitamin B6, iron, vitamin D, vitamin C, and vitamin B12 (1). Because NHANES does not assess the status of all vitamins and minerals, there may be other micronutrient deficiencies that are present in the population without an estimated prevalence.

According to NHANES data from 2005-2012, a significant proportion of women who participate in WIC have inadequate nutrient intakes of vitamin E (96-100%). Additionally, greater than 50% of pregnant women participants reported inadequate intakes of iron and between 10-50% reported inadequate intakes of magnesium, folate, zinc, vitamin A, vitamin C, and vitamin B6 (5).

Micronutrient deficiencies during pregnancy are not only a concern for the mother, but are of great concern to the developing fetus that is at risk of certain birth defects related to inadequate levels of certain nutrients including B vitamins, vitamin K, magnesium, copper, and zinc (6).

Iodine deficiency during pregnancy can lead to irreversible adverse effects on fetal growth and development. Iodine deficiency is the leading cause of intellectual disability worldwide.

According to NHANES data from 2005-2008, 56.9% of the pregnant women surveyed had urinary iodine concentrations below the established threshold of 150mcg/L. This finding suggests that greater than half of pregnant women have insufficient intakes of iodine (7). Because intake patterns of pregnant women can exclude or limit specific food groups, it is not uncommon to have multiple nutrient deficiencies during pregnancy (8). For example, iron deficiency usually does not occur alone, but it often occurs in conjunction with other vitamin and mineral deficiencies (9).

Intakes of nutrients were also found to be low among postpartum and breastfeeding women participating in WIC. Among women who were breastfeeding and participating in WIC, more than 50% had inadequate intakes of vitamin A, and 10-50% had inadequate intakes of magnesium, zinc, vitamin C, vitamin B6, folate, copper, and calcium (5). Greater than 50% of postpartum women who were not breastfeeding were found to have inadequate intakes of magnesium, vitamin A, and calcium, while 10-50% had inadequate intakes of vitamin C, folate, copper, zinc, thiamin, vitamin B6, vitamin B12, iron, and riboflavin (5).

According to NHANES data from 2011-2012, formula fed infants had an average usual intake of

choline that was below the AI for that nutrient; however, intakes of other vitamins and minerals were estimated to be adequate (5). Intakes of vitamin D, iron, and zinc among breastfed infants can be of concern if appropriate and timely complementary foods and/or vitamin and mineral supplements are not provided to the infant. According to NHANES data from 2009-2012, at least 10% of infants receiving human milk between 6 and 12 months of age had inadequate intakes of iron and zinc (5). Concentrations of vitamin D in human milk hav

been found to be low. Therefore, it has been recommended by the American Academy of Pediatrics (AAP) to provide all infants who are taking less than 32 ounces of formula a day a vitamin D supplement of 400 IU daily (10, 11). Additionally, infants who are born to mothers who are vitamin D deficient are more likely to be deficient themselves. (For more information see risk 411 *Inappropriate Nutrition Practices for Infants*.)

For children participating in the WIC program, the prevalence of inadequate intakes of nutrients was found to be less than 5% for each nutrient, except vitamin E, which was found to be inadequate in the diets of 34.9% of children between 2 and 5 years of age (5). Additionally, it has been estimated that one in four children does not meet the RDA for iron, and one in ten does not meet the RDA for calcium (12).

In addition to health risks associated with low nutrient status, some micronutrients pose a health risk at levels higher than the established UL. For this reason, individuals with nutrient deficiency diseases, or who are concerned that they may have a nutrient deficiency disease, should be followed by their medical provider (especially if supplements are required for treatment).

Populations who may be at greater risk of nutrient deficiencies or diseases include:

* Individuals who have intakes below the established RDA, AI, or EAR for the nutrient.
* Individuals who experience food insecurity.
* Individuals who are experiencing homelessness.
* Women who have a short interpregnancy interval.
* Individuals who have recently left their previous country of residence.
* People with a gastrointestinal disease that can limit absorption of nutrients (i.e. celiac disease or Crohn’s disease) or individuals with a history of gastrointestinal surgery (including gastric bypass). For example, individuals who have had a portion of their stomach removed or their distal ileum removed during a weight-loss or other surgery are at a greater risk of developing a vitamin B12 deficiency (13).
* Individuals with other medical conditions that influence nutrient status (i.e. cystic fibrosis, renal disease, genetic disorders).
* Individuals on medications that are known to interact with the absorption or excretion of certain vitamins and minerals.
* People with substance use disorders (including alcohol) may be more likely to have deficiencies due to poor intake and/or the effects of the substance. People who have high intakes of alcohol are at greater risk of developing a magnesium deficiency (14, 15).
* People who smoke are more likely to have a vitamin C deficiency due to the increase in oxidative stress.

Nutrient deficiencies or diseases can be subclinical or clinical. Subclinical deficiencies involve

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changes to the concentrations of the micronutrient in the blood or tissues. Clinical deficiencies involve noticeable changes to the appearance of skin, nails, hair, oral cavity, and bone formation as well as major disturbances in the function of cells and tissues in the body. At either stage of a nutrient deficiency, blood work is often taken to confirm a deficiency. Blood work to detect nutrient deficiencies can be misleading, as some nutrients, such as magnesium, may have an overall deficiency in the body but be at a normal level in the blood (15). Other methods can be used to assess for nutrient deficiency disease, such as a physical

nutrition assessment. Because it can be difficult to be tested for, and diagnosed with, a nutrient deficiency or a nutrient deficiency disease can go undetected and untreated.

The table below provides information regarding specific nutrients that are more commonly of concern among the WIC population; however, additional nutrient deficiency diseases may occur in the population. Detailed fact sheets about each nutrient can be found at the National Institutes of Health Office of Dietary Supplements website: https://ods.od.nih.gov/factsheets/list-all/.

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| --- | --- | --- |
| **Nutrient** | **Function** | **Signs and Symptoms of Deficiency** |
| Vitamin A | Involved in immune function, vision, cell growth and cell  communication. | Night blindness and xerophthalmia (16). |
| Vitamin B6 | Involved in greater than 100 enzyme reactions in the body and involved in protein metabolism. | Microcytic anemia, scaling of the lips and cracks in the corners of the mouth, swollen tongue, depression, and  confusion (17). |
| Vitamin B12 | Involved in red blood cell formation, neurological function, and DNA synthesis. | Megaloblastic anemia, fatigue, weakness, constipation, loss of appetite, and weight loss (13). |
| Vitamin C | Involved in the formation of collagen, certain neurotransmitters, and protein synthesis. | Development of scurvy which would include: fatigue, inflammation of the gums, and weakened connective tissue (14). |
| Vitamin D | Promotes calcium absorption and proper bone formation, involved in cell growth, immune function, and reduces inflammation. | Development of rickets in children or osteomalacia in adults, and fatigue (18). |
| Calcium | Involved in muscle function, nerve transmission, and proper bone formation. | Development of osteoporosis (19). |
| Folate | Involved in the synthesis of RNA and DNA and is required for cell division and the prevention of Neural Tube Defects. | Megaloblastic anemia (20). |
| Iodine | A component of thyroid hormones that regulate protein synthesis, metabolism, and enzyme activity. | Stunted growth and neurodevelopmental deficits (7). |

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| --- | --- | --- |
| Iron | A component of hemoglobin and therefore important in the transfer of oxygen from the lungs to organs, and involved in the synthesis of  hormones as well as normal growth and development. | Microcytic, hypochromic anemia; impaired cognitive function, poor body temperature regulation, depressed immune function, and spoon like shape of nails (9). |
| Magnesium | Involved in more than 300 enzyme | Loss of appetite, fatigue, weakness, nausea, |

|  |  |  |
| --- | --- | --- |
| **Nutrient** | **Function** | **Signs and Symptoms of Deficiency** |
| Magnesium (continued) | reactions, protein synthesis, muscle function, nerve function,  blood sugar control, and blood pressure control. | vomiting, numbness, tingling, muscle cramps, seizures, personality changes, and abnormal heart rhythms (15). |
| Zinc | Involved in cell metabolism, enzyme activity, immune function, protein synthesis, wound healing, DNA synthesis, and cell division. | Stunted growth, depressed immune function, hair loss, eye and skin lesions, delayed wound healing, and taste alterations (21). |

Implications for WIC Nutrition Services

The WIC food package is designed to include foods that contain specific nutrients to improve the health status of program participants, address inadequate intakes, and, ultimately, prevent nutrient deficiencies. Nutrition education combined with the WIC food package can help decrease the likelihood that an individual would develop a nutrient deficiency or disease. For individuals who currently have a nutrient deficiency or disease, WIC staff can:

* Encourage improved intake of whole grains, legumes, dairy, lean protein, fruits, and vegetables.
* Emphasize appropriate portion size and variety to avoid nutrient to nutrient interaction. (For example, excessive calcium intake inhibits the absorption of iron.)
* Provide education on foods that contain the specific nutrient(s) of concern.
* Provide education on preparing foods that are part of the WIC food package.
* Refer individuals who report food insecurity to appropriate resources in the community like the Supplemental Nutrition Assistance Program (SNAP) and/or food pantries.
* Reinforce the medical and dietary treatment plans provided by the medical provider, and refer participants to medical providers for medical follow-up care.
* Refer individuals who smoke to tobacco cessation program

