

Conditions that May Be Improved by Nutrient Supplementation		
Disease	Nutrient(s)	Rationale
Anaemia, microcytic	Iron	Increased need in high-risk groups (e.g., pregnant adolescents)
Anaemia, pernicious	Vitamin B12	Elderly individuals, post gastrectomy patients
Burn injury	Vitamins A, D & E; carotenoids; selenium, zinc, copper	Low blood levels; increases needed to support immune function
Celiac sprue	Vitamins D, E & K; B-vitamins; iron, calcium, zinc, magnesium	Restricted diet increases risk for deficiency
Congestive heart failure	Thiamine, magnesium	Loss due to diuretics may further compromise cardiac function
Cystic fibrosis	Vitamins A, D, E, K & C; selenium, zinc	Malabsorption, low blood levels; greater oxidative stress
Eating disorders	Multivitamin/mineral, calcium, vitamin D	Poor intake; evidence of deficiency; reversal of osteoporosis in patients with anorexia nervosa
End-stage kidney disease	B-vitamins, vitamin C	Losses due to dialysis treatment
Inflammatory bowel disease	Beta-carotene, vitamins C, D & E; selenium, zinc	Malabsorption
Macular degeneration	C, E, beta-carotene; zinc, copper, lutein	Reduction of oxidative stress in the macula; some evidence of benefit in clinical trials
Osteoporosis	Calcium, vitamin D	Elderly individuals; persons on long-term corticosteroid treatment

KNOW MORE ABOUT THE ROLE OF SOME MICRONUTRIENTS IN HEALTH & DISEASE AND PREVENT / TREAT YOURSELF AND YOUR FAMILY OF MICRONUTRIENT DEFICIENCY –HIDDEN HUNGER AND ENJOY A DISEASE FREE LONG LIFE

Vitamin	Functions/Roles in metabolism	Deficiency Symptoms	Recommended Dietary Allowance
Vitamin A	Bone growth, reproduction, cell division, immunity, cell differentiation	Clinical: Night blindness; total blindness (rare in the U.S.) Subclinical: May increase risk for respiratory and diarrheal infections;	Adults: Age 19+: Males: 900 µg Females: 700 µg

		decrease growth rate; slow bone development; and decrease likelihood of survival from serious illness	<p>Infants/children: (*)</p> <p>0–6 months: 400 µg</p> <p>7–12 months: 500 µg</p> <p>1–3 years: 300 µg</p> <p>4–8 years: 400 µg</p> <p>9–13 years: 600 µg</p> <p>14–18 years (boys): 900 µg</p> <p>14–18 years (girls): 700 µg</p> <p>Pregnancy:</p> <p>Age ≤ 18: 750 µg</p> <p>Age 19+ 770 µg</p> <p>Lactation:</p> <p>Age ≤ 18: 1,200 µg</p> <p>Age 19+: 1,300 µg</p>
<b>Vitamin D</b>	Maintenance of normal blood levels of calcium and phosphorus; promotes bone mineralization; regulates cell growth, differentiation, immune function	<p>In children: rickets</p> <p>In adults: <i>osteomalacia</i></p>	<p>Adults:*</p> <p>Ages 19–70: 15 µg/600 IU</p> <p>Ages 70+: 20 µg/800 IU</p> <p>Infants /children:</p> <p>0-12 months: 10 µg/400 IU*</p> <p>1–18 years: 15 µg/600 IU</p> <p>Pregnancy/ lactation:</p> <p>15 µg/600 IU</p>
<b>Vitamin E</b>	Antioxidant (protects cells against free radicals); plays role in immune function and in DNA repair; inhibits cell proliferation, platelet aggregation, and monocyte adhesion <sup>1</sup>	Nerve degeneration in hands and feet	<p>Adults: 19+ years: 15mg</p> <p>Infants/children: (*)</p> <p>0–6 months: 4mg</p> <p>7–12 months: 5mg</p> <p>1–3 years: 6mg</p> <p>4–8 years: 7mg</p> <p>9–13 years: 11mg</p> <p>14–18 years: 15mg</p> <p>Pregnancy: 15mg</p> <p>Lactation: 19mg</p>
<b>Vitamin K</b>	Coenzyme for synthesis of proteins involved in blood coagulation and bone metabolism	Increase in prothrombin time; in severe cases, haemorrhagic events	<p>Adults: 19+ years: (*)</p> <p>Males: 120 µg</p> <p>Females: 90 µg</p> <p>Infants/children: (*)</p> <p>0–6 months: 2 µg</p> <p>7–12 months: 2.5 µg</p> <p>1–3 years: 30 µg</p> <p>4–8 years: 55 µg</p> <p>9–13 years: 60 µg</p> <p>14–18 years (boys): 120 µg</p>

			<p>14–18 years (girls): 75 <math>\mu\text{g}</math></p> <p>Pregnancy/lactation:  Girls <math>\leq 18</math> years: 75 <math>\mu\text{g}</math>  Adults 19 + years: 90 <math>\mu\text{g}</math></p>
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Vitamin	Functions /Roles in Metabolism	Deficiency Symptoms	Recommended Dietary Allowance
<b>Vitamin C</b>	Antioxidant; biosynthesis of connective tissue components (collagen, elastin, fibronectin, proteoglycans, bone matrix, and elastin-associated fibrillin); carnitine, and neuro-transmitters	Scurvy (involves deterioration of elastic tissue); follicular hyperkeratosis, petechiae, ecchymosis, coiled hairs, inflamed and bleeding gums, perifollicular haemorrhages, joint effusions, arthralgia, and impaired wound healing; dyspnoea, oedema, Sjögren syndrome, weakness, fatigue, depression	<p>Adults (<math>\geq 19</math> years):  Males: 90mg  Females: 75mg</p> <p>Infants/children: (*)  0–6 months: 40mg  7–12 months: 50mg  1–3 years: 15mg  4–8 years: 25mg  9–13 years: 45mg  14–18 years (boys): 75mg  14–18 years (girls): 65mg</p> <p>Pregnancy:  Age <math>\leq 18</math>: 80mg  Age 19–50: 85mg</p> <p>Lactation:  Age <math>\leq 18</math>: 115mg  Age 19+: 120mg</p>
<b>Thiamine (B1)</b>	Coenzyme in the metabolism of carbohydrates and branched-chain amino acids	Anorexia; weight loss; mental changes such as apathy, decrease in short-term memory, confusion, and irritability; muscle weakness; cardiomegaly; beriberi (polyneuritis)	<p>Adults (<math>\geq 19</math> years):  Males: 1.2mg  Females: 1.1mg</p> <p>Infants/children: (*)  0–6 months: 0.2mg  7–12 months: 0.3mg  1–3 years: 0.5mg  4–8 years: 0.6mg  9–13 years: 0.9mg  14–18 years (boys): 1.2 mg  14–18 years (girls): 1.1 mg</p> <p>Pregnancy/lactation: 1.4 mg</p>
<b>Riboflavin (B2)</b>	Coenzyme in numerous redox reactions	Ariboflavinosis; sore throat; hyperaemia and oedema of pharyngeal and oral mucous membranes; cheilosis; angular stomatitis; glossitis (magenta tongue);	<p>Adults (ages 19+):  Males: 1.3mg  Females: 1.1mg</p>

		seborrheic dermatitis; normochromic, normocytic anaemia	<p>Infants/children: (*)</p> <p>0–6 months: 0.3mg</p> <p>7–12 months: 0.4mg</p> <p>1–3 years: 0.5mg</p> <p>4–8 years: 0.6mg</p> <p>9–13 years (boys): 0.9mg</p> <p>14–18 years (boys): 1.3mg</p> <p>9–13 years (girls): 0.9mg</p> <p>14–18 years (girls): 1.0mg</p> <p>Pregnancy: 1.4mg</p> <p>Lactation: 1.6mg</p>
<b>Niacin (B3)</b>	Coenzyme in numerous redox reactions	Pellagra (pigmented rash, vomiting, constipation or diarrhoea, bright red tongue; neurological symptoms including depression, apathy, headache, fatigue, and loss of memory)	<p>Adult males and males <math>\geq</math>age 14: 16mg</p> <p>Adult females and females <math>\geq</math>age 14: 14mg</p> <p>Infants/children: (*)</p> <p>0–6 months: 2.0mg</p> <p>7–12 months: 4.0mg</p> <p>1–3 years: 6.0mg</p> <p>4–8 years: 8.0mg</p> <p>9–13 years (boys): 12.0mg</p> <p>Pregnancy: 18mg</p> <p>Lactation: 17mg</p>
<b>Pantothenic acid (B5)</b>	Component of coenzyme A; cofactor and acyl group carrier for many enzymatic processes, and acyl carrier protein, a component of the fatty acid synthase complex	Extremely rare; irritability and restlessness; fatigue; apathy; malaise; sleep disturbances; gastro–intestinal complaints such as nausea, vomiting, and abdominal cramps; neurobiological symptoms such as numbness, paraesthesia's, muscle cramps, staggering gait	<p>Adults (ages 19+): 5.0mg</p> <p>Infants/children: (*)</p> <p>0–6 months: 1.7mg</p> <p>7–12 months: 1.8mg</p> <p>1–3 years: 2.0mg</p> <p>4–8 years: 3.0mg</p> <p>9–13 years (boys): 4.0mg</p> <p>14–18 years (boys): 5.0mg</p> <p>Pregnancy: 6.0mg</p> <p>Lactation: 7.0mg</p>
<b>Pyridoxine (B6)</b>	Coenzyme in the metabolism of amino acids, glycogen, and sphingoid bases	Seborrheic dermatitis, microcytic anaemia, epileptiform convulsions	<p>Adults:</p> <p>Ages 19–50: 1.3mg</p> <p>Age 51+ (males): 1.7mg</p> <p>Age 51+ (females): 1.5mg</p> <p>Infants/children: (*)</p> <p>0–6 months: 0.1mg</p> <p>7–12months: 0.3mg</p>

			1–3 years: 0.5mg 4–8 years: 0.6mg 9–13 (boys/girls): 1.0mg 14–18 years (boys): 1.3mg 14–18 years (girls): 1.2mg  Pregnancy: 1.9mg Lactation: 2.0mg
<b>Folic acid</b>	Coenzymes are involved in DNA synthesis; amino acid interconversions; single–carbon metabolism; methylation reactions	Early sign: hyper segmented neutrophils Late sign: macrocytic anaemia (weakness, fatigue, difficulty concentrating, irritability, headache, palpitations, shortness of breath)	Adults (ages 19+): 400 µg  Infants/children: (*) 0–6 months: 65 µg 7–12months: 80 µg 1–3 years: 150 µg 4–8 years: 200 µg 9–13 years: 300 µg 14–18 years: 400 µg  Pregnancy: 600 µg Lactation: 500 µg
<b>Vitamin B12</b>	Cofactor for methionine synthase and L–methyl–malonyl–CoA mutase; essential for normal blood formation and neurologic function	Pernicious anaemia; neuro–logic manifestations (sensory disturbances in the extremities; motor disturbances, including abnormalities of gait); cognitive changes (loss of concentration; memory loss, disorientation and frank dementia); visual disturbances, insomnia, impotency, and impaired bowel and bladder control	Adults (ages 19+): 2.4 µg  Infants/children: (*) 0–6 months: 0.4 µg 7–12months: 0.5 µg 1–3 years: 0.9 µg 4–8 years: 1.2 µg 9–13 years: 1.8 µg 4–18 years: 2.4 µg  Pregnancy: 2.6 µg Lactation: 2.8 µg

<b>Biotin</b>	Coenzyme in bicarbonate–dependent carboxylation reactions (e.g., acetyl–CoA carboxylase, pyruvate carboxylase)	Dermatitis, conjunctivitis, alopecia, and central nervous system abnormalities (depression, lethargy, hallucinations, and paraesthesia of the extremities)	Adults (ages 19+) (*): 30 µg  Infants/children: (*) 0–6 months: g 7–12 months: 6 µg 1–3 years: 8 µg 4–8 years: 12 µg 9–13 years: 20 µg 14–18 years: 25 µg  Pregnancy: 30 µg Lactation: 35 µg
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<b>Choline</b>	Synthesis and release of acetylcholine; precursor for the synthesis of cell membrane components (phospholipids and sphingomyelin), platelet activating factor, and betaine (important in metabolism of homocysteine)	Steatosis, liver damage	Men (ages 19+): 550mg Women (ages 19+): 425mg  Infants/children: (*) 0–6 months: 125mg 7–12months: 150mg 1–3 years: 200mg 4–8 years: 250mg 9–13 (boys/girls): 375mg 14–18 years (boys): 550mg 14–18 years (girls): 400mg  Pregnancy: 450 mg Lactation:550 mg
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Mineral	Biochemical Role/Function	Deficiency Symptoms	Recommended Dietary Allowance or AI (*)
<b>Calcium (Ca)</b>	Component of teeth and bones; mediates vascular contraction and vaso-dilation, muscle contraction, nerve transmission, and glandular secretion	Reduced bone mass and osteoporosis	Adults: Ages 19–50: 1,000 mg Ages 51-70, males: 1,000 mg Ages 51-70, females: 1,200 mg Ages 71+: 1,200 mg  Infants/children: 0–6 months: 200 mg* 7–12 months: 260 mg* 1–3 years: 700 mg 4–8 years: 1,000 mg 9–18 years: 1,300 mg  Pregnancy/lactation:* Ages 14-18: 1,300mg Ages19+: 1,000 mg
<b>Phosphorus (P)</b>	Component of most biological membranes and nucleotides and nucleic acids; buffering of acid or alkali excesses; temporary storage and transfer of the energy derived from metabolic fuels; activation of many catalytic proteins through phosphorylation	Anorexia, anaemia, muscle weakness, bone pain, rickets and osteomalacia, general debility; may be seen in persons recovering from alcoholic bouts; in diabetic keto-acidosis; in refeeding with calorie-rich sources without paying attention to phosphorus needs; & with AL-containing antacids	Adults (ages 19+): 700 mg  Infants/children: (*) 0–6 months: 100 mg 7–12months: 275mg 1–3 years: 460 mg 4–8 years: 500 mg 9–18 years: 1,250 mg  Pregnancy/lactation: Age ≤18: 1,250 mg Age 19+: 700 mg
<b>Magnesium (Mg)</b>	Required cofactor for over 300 enzymes, including ones involved in anaerobic and	Hypocalcaemia; neuro-muscular hyper excitability& latent tetany; insulin resistance and impaired insulin secretion	Adults: <u>Ages 19–30</u> males: 400 mg females: 310 mg <u>Ages 31+</u>

	aerobic energy generation, glycolysis, and oxidative phosphorylation; DNA and RNA synthesis; activation of adenylate cyclase; sodium, potassium–ATPase activity; has a calcium channel–blocking effect		<p>males: 420 mg females: 320 mg</p> <p>Infants/children: (*) 0–6 months: 30 mg 7–12months: 75 mg 1–3 years: 80 mg 4–8 years: 130 mg 9–13 years: 240 mg 14–18 years: (males) 410 mg (females) 360 mg</p> <p>Pregnancy: Ages <math>\leq 18</math>: 400 mg Ages 19–30: 350 mg Ages 31–50: 360mg</p> <p>Lactation: Ages <math>\leq 18</math>: 360 mg Ages 19–30: 310 mg Ages 31–50: 320 mg</p>
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Source: Institute of Medicine.

Mineral	Biochemical role/function	Deficiency symptoms	Recommended Dietary Allowance or AI (*)
<b>Potassium(K)</b>	Neural transmission; muscle contraction, vascular tone	Cardiac arrhythmias; muscle weakness; leg discomfort; extreme thirst; frequent urination; confusion; glucose intolerance, increased blood pressure, increased salt sensitivity, increased risk for kidney stones, increased bone turnover	<p>Adults &amp; children: <math>\geq 14</math> years of age: (*) 4,700 mg</p> <p>Infants/children: (*) 0–6 months: 400 mg 7–12months: 700mg 1–3 years: 3,000 mg 4–8 years: 3,800 mg 9–13 years: 4,500 mg</p> <p>Pregnancy:(*) 4,700 mg Lactation:(*) 5,100 mg</p>
<b>Sodium (Na)</b>	Maintenance of extra–cellular volume and plasma osmolality; is an important determinant of the membrane potential of cells and the active transport of molecules across cell membranes	Brain swelling, resulting in loss of appetite, nausea, vomiting, headache, mental status changes (confusion, irritability, fatigue, hallucinations); muscle weakness, convulsions	<p>Adults: 19–50 years: (*) 1,500 mg 51–70 years: 1,300 mg 70+ years: 1,200 mg</p> <p>Infants/children: (*) 0–6 months: 120 mg 7–12months: 370mg</p>

			1–3 years: 1,000 mg 4–8 years: 1,200 mg 9–18 years: 1,500 mg  Pregnancy:(*) 1,500 mg Lactation:(*)2,300 mg
<b>Chloride (Cl)</b>	Important component of gastric juice as hydrochloric acid	Hypochloraemia metabolic alkalosis. In infants, hypochloraemia results in growth failure, lethargy, irritability, anorexia, gastrointestinal symptoms, and weakness; may also result in hypokalaemia, metabolic alkalosis, haematuria, hyper–aldosteronism, and increased plasma renin	Adults: 19–50 years:(*) 2,300 mg 51–70 years: 2,000mg > 70 years: 1,800 mg  Infants/children: (*) 0–6 months: 180mg 7–12months: 570mg 1–3 years: 1,500mg 4–8 years: 1,900mg 9–18 years: 2,300mg  Pregnancy: (*) 2,300mg Lactation:(*) 2,300mg

Source: Institute of Medicine.

Mineral	Biochemical Role/Function	Deficiency Symptoms	Recommended Dietary Allowance or AI (*)
<b>Iron</b>	Component of enzymes necessary for oxidative metabolism; heme proteins (haemoglobin, myoglobin, cytochromes); participates in electron transfer	Impaired physical work performance, develop–mental delay, cognitive impairment, anaemia	Adults: Men 19+ & women 51+: 8.0 mg Women (age 19–50): 18.0 mg  Infants/children: 0–6 months:(*) 0.27 mg 7–12 months: 11,mg 1–3 years: 7,mg 4–8 years: 10 mg 9–13 years: 8 mg 14–18 years (boys): 11 mg 14–18 years (girls): 15 mg  Pregnancy: 27 mg Lactation: 14–18 years: 10 mg 19–50 years: 9mg
<b>Zinc</b>	Component of enzymes (RNA polymerase, alkaline phosphatase); structural role for	Growth retardation, hair loss,	Adults (ages 19+): Men: 11.0 mg Women: 8.0 mg



	some enzymes and in protein folding; anti-oxidant function as part of zinc-copper SOD	diarrhoea, delayed sexual maturation and impotence, eye and skin lesions, loss of appetite, delayed wound healing	<p>Infants/children:</p> <p>0–6 months: (*) 2 mg</p> <p>7 months to 3 years: 3 mg</p> <p>4–8 years: 5 mg</p> <p>9–13 years: 8 mg</p> <p>14–18 years (boys): 11 mg</p> <p>14–18 years (girls): 9 mg</p> <p>Pregnancy:</p> <p>14 to 18 years: 12 mg</p> <p>19+ years: 11 mg</p> <p>Lactation:</p> <p>≤ 18 years: 13 mg</p> <p>19+ years: 12 mg</p>
<b>Copper</b>	Component of metallo-enzymes (oxidases; e.g., monoamine oxidase; lysyl oxidase used for collagen and elastin production; cytochrome c oxidase; dopamine β mono-oxygenase); part of zinc-copper SOD	Defects in connective tissue; anaemia; immune and cardiac dysfunction	<p>Adults (ages 19+): 900 µg</p> <p>Infants/children: (*)</p> <p>0–6 months: 200 µg</p> <p>7–12 months: 220 µg</p> <p>1–3 years: 340 µg</p> <p>4–8 years: 440 µg</p> <p>9–13 years: 700 µg</p> <p>14–18 years: 890 µg</p> <p>Pregnancy: 1000 µg</p> <p>Lactation: 1300 µg</p>
<b>Chromium</b>	Potentiation of insulin action; mobilize the glucose transporter, GLUT4, to the plasma membrane ( <i>Mol Endocrinol.</i> 2006;20:857–870); enhances tyrosine phosphorylation of the insulin receptor ( <i>Biochemistry.</i> 2005;44:8167–8175)	Rare; found in patients on TPN prior to inclusion of Cr+3; symptoms included weight loss, neuropathy, and impaired glucose tolerance	<p>Adults:</p> <p>Men (age 19–50): 35 µg</p> <p>Women (age 19–50): 25 µg</p> <p>Males (age 50+): 30 µg</p> <p>Females (age 50+): 20 µg</p> <p>Infants/children: (*)</p> <p>0–6 months: 0.2 µg</p> <p>7–12 months: 5.5 µg</p> <p>1–3 years: 11 µg</p> <p>4–8 years: 15 µg</p> <p>9–13 years (males): 25 µg</p> <p>9–13 years (females): 21 µg</p> <p>14–18 years (males): 35 µg</p> <p>14–18 years (females): 24 µg</p> <p>Pregnancy: 30 µg</p> <p>Lactation: 45 µg</p>

Mineral	Biochemical role/function	Deficiency symptoms	Recommended Dietary Allowance or AI (*)
<b>Selenium</b>	Defence against oxidative stress, regulation of thyroid hormone action, and regulation of the redox status of vitamin C and other molecules, through selenoproteins; e.g., oxidant defence enzymes like glutathione peroxidase; iodothyronine deiodinases	Keshan disease (cardiomyopathy in paediatric population); skeletal muscle disorders manifested by muscle pain, fatigue, proximal weakness, and serum creatine kinase (CK) elevation ( <i>Muscle Nerve</i> .2003;27:662–668)	Adults (ages 19+): 55 µg  Infants/children: (*) 0–6 months: 15 µg 7–12 months: 20 µg 1–3 years: 20 µg 4–8 years: 30 µg 9–13 years: 40 µg 14–18 years: 55 µg  Pregnancy: 60 µg Lactation: 70 µg
<b>Iodine</b>	Component of the thyroid hormones thyroxine (T4) and triiodothyronine (T3)	Mental retardation, hypothyroidism, goitre, cretinism, and varying degrees of other growth and developmental abnormalities	Adults (ages 19+): 150 µg  Infants/children: 0–6 months:(*) 110 µg 7–12 months:(*) 130 µg 1–3 years: 90 µg 4–8 years: 90 µg 9–13 years: 120 µg 14–18 years: 150 µg  Pregnancy: 220 µg Lactation: 290 µg
<b>Manganese</b>	Component of metallo–enzymes (arginase, manganese superoxide dismutase, pyruvate carboxylase)	Dermatitis, hypocholesterolaemia	Adults (ages 19+): (*) Men: 2.3 mg Women: 1.8 mg  Infants/children: (*) 0–6 months: 3 µg 7–12 months: 0.6 mg 1–3 years: 1.2 mg 4–8 years: 1.5 mg 9–13 years (boys): 1.9 mg 9–18 years (girls): 1.6 mg 14–18 years (boys): 2.2 mg  Pregnancy: (*) 2 mg Lactation: (*) 2.6 mg
<b>Molybdenum</b>	Component of	Rare; initially seen in	Adults (ages 19+): 45 µg

<b>(MO)</b>	sulphite oxidase, xanthine oxidase, aldehyde oxidase, enzymes involved in catabolism of sulphur-containing amino acids, purines, and pyridines	patients on TPN, before addition of MO to standard TPN regimes; resulted in tachycardia, headache, night blindness, low serum uric acid	<p>Infants/children: (*)</p> <p>0–6 months: 2 <math>\mu\text{g}</math></p> <p>7–12 months: 3 <math>\mu\text{g}</math></p> <p>1–3 years: 17 <math>\mu\text{g}</math></p> <p>4–8 years: 22 <math>\mu\text{g}</math></p> <p>9–13 years: 34 <math>\mu\text{g}</math></p> <p>14–18 years (males): 43 <math>\mu\text{g}</math></p> <p>Pregnancy/lactation: 50 <math>\mu\text{g}</math></p>
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