

Vitamins

Vitamin	Function	Dietary sources	Causes of deficiency	Risk groups, prevalence	Clinical findings	Screening and management
A Forms - retinol, retinal, retinoic acid or retinyl ester	Fat soluble vitamin - Epithelial cell function, vision, immune function, embryo development	Preformed in animal foods (liver, fish, butter, cheese, whole milk, egg yolk), carotenoids in plant based foods (orange/ yellow fruits and vegetables)	Low vitamin A content in breast milk, restricted food access, alcoholism	Infants, children, pregnant/lactating women, alcoholism Intestinal failure, biliary, pancreatic disease, PEM Anecdotal reports Rohingya populations	Dry eyes, night blindness, increased infections, hyperkeratotic rash (goose bump rash), Bitot's spots on conjunctivae, corneal ulceration and scarring, blindness; anaemia, poor growth	Screen if: Clinical signs deficiency Post arrival in children from refugee camps or situations with poor access to food, or where fat malabsorption suspected. See: Vitamin A guidelines
B1 Thiamine	Water soluble vitamin - role in oxidative phosphorylation and pentose phosphate pathway (carbohydrate metabolism)	Cereal foods, including wheat germ, wheat bran, wholemeal flour, pork, beef, liver, kidney, legumes, nuts, yeast extract, (Vegemite), nuts, peas, sesame seeds	Rice based diets, foods with thiaminases/anti-thiamine compounds, ↑req'mts pregnancy lactation	Endemic in areas with rice based diets, anecdotal reports in Karen refugee children pre-arrival with polished rice diet Alcoholism, HIV, jejunal disease (site absorption)	Weakness with intercurrent illness, anorexia; irritability; beriberi - cardiovascular symptoms and/or symmetric peripheral neuropathy, Wernicke encephalopathy (confusion, reduced consciousness, ataxia, ophthalmoplegia) Korsakoff syndrome (memory disorder, confabulation) - beri-beri and WKS do not usually occur together	Screen if: History weakness with intercurrent illness Thiamine dosing
B2 Riboflavin	Water-soluble vitamin - coenzyme in TCA, fatty acid synthesis, synthesis of B3, conversion B6 to active form	Milk, dairy, fortified bread/cereal, eggs, pulses, green vegetables, almonds, yeast extract	Corn based diets	Corn based diets (Africa, India, parts of China)	Angular stomatitis, cheilitis, glossitis, dermatitis, elevated homocysteine, normocytic anaemia	Not usually measured Riboflavin dosing
B3 Niacin Nicotinic acid and nicotinamide	Water soluble vitamin - coenzyme dehydrogenase-reductase reactions including glycolysis, and fatty acid metabolism	Beans, milk, beef, pork, liver, eggs, wheat,	Restricted food access Maize based diets	Restricted food access, rice based diets	Pellagra – dermatitis (hyperpigmented skin and mucosal changes, photosensitivity), diarrhoea, dementia, glossitis, anorexia, weakness, irritability	Not usually measured Niacin dosing – see NRV
B5 Pantothenic acid	Part of coenzyme A, reactions involving CHO, protein and lipid metabolism	Organ meat, chicken, beef, potatoes, oats, grains, tomatoes, eggs, peanuts, green vegetables	Restricted food access	Restricted food access, rice based diets	Very rare – gastrointestinal Sx, depression, irritability, burning sensation feet, low BSL,	Not usually measured B5 dosing – see NRV
B6 Pyridoxine	Cofactor enzymes in aminotransferase reactions inc. aminolevulinic acid and serotonin	All food groups esp. legumes, nuts, wheat, meat, bananas	Restricted food access Isoniazid treatment (↑urine excretion)	Restricted food access, rice based diets	Microcytic, hypochromic anemia (↓heme synthesis), dermatitis, cheilitis, stomatitis, peripheral neuropathy, seizures, ↓AST and ALT	Not usually measured Pyridoxine dosing
B7 Biotin	Water-soluble vitamin, cofactor for carboxylases	Organ meat, eggs, dairy, synthesis by intestinal bacteria	Anticonvulsants, hemodialysis, parenteral nutrition large amounts raw egg whites	Haemodialysis, PN dependent patients	Dermatitis, glossitis, alopecia, poor growth, ataxia, weakness, depression and seizures	Not usually measured Biotin dosing
B12 Cyanocobalamin	Water-soluble vitamin - DNA synthesis, branched chain amino acid metabolism	Animal based foods, muscle meat, fish, eggs, dairy, yeast, synthesis by intestinal bacteria	Vegan diets	Vegans, restricted food access Breastfed infants of mothers with deficiency Gastric atrophy People from Iran, Iraq, Afghanistan, Bhutan	glossitis, stomatitis, weakness, Megaloblastic anaemia, hypersegmented neutrophils, ↑homocysteine, ↑methylmalonic acid	Consider screen – Iran, Bhutan, Afghanistan, Iran Screen in exclusively breastfed infants where maternal deficiency suspected, or where deficiency suspected Vitamin B12 guideline
C Ascorbic acid	Water-soluble vitamin, antioxidant collagen synthesis, neurotransmitter and carnitine production, enzyme f'n	Citrus fruits, broccoli tomatoes, potatoes, berries, guava, mango, capsicum, pawpaw, parsley, pineapple, spinach and cabbage	Diets without fruit and vegetables	Restricted eating/food access, sometimes seen in autism	↓absorption iron, ↓collagen formation, ↓immune function, ↓wound healing Scurvy: perifollicular haemorrhage, gum bleeding, bruising, oedema, weakness, bony changes on XR	Screen if clinical signs deficiency, poor fresh food access Vitamin C dosing
D Cholecalciferol (D3) or ergocalciferol (D2)	Fat soluble vitamin - calcium and phosphate balance Bone health, emerging evidence influences cardiovascular health, pregnancy outcomes and immunity/atopy	Skin synthesis - most important source of vitamin D for all ages, diet is a poor source of vitamin D for all ages, (generally 10 – 25%) – found in some fatty fish, added to margarine, breast milk content ~25 IU/L, formula 380 – 520 IU/L	Lack of skin exposure to UVB in sunlight Dark skin Conditions/medications affecting D metabolism Infants: maternal deficiency and BF with one or more other risk factors	Lack of skin exposure to sun, dark skin Medications/conditions affecting vit D metabolism inc obesity Exclusively breastfed Infants born to deficient mothers, who have at least 1 other risk factor	Bone pain Muscle pain Delayed dental eruption Poor growth Late motor milestones Rickets	Screen if at least one risk factor Vitamin D guideline
E Alpha-tocopherol and other forms	Fat soluble vitamin - antioxidant esp. for PUFA, protects cell membranes, reg'n prostaglandin synthesis	Plant oils, including wheat germ, sunflower, canola, olive, less in corn oil and soy oil	Fat malabsorption	Intestinal failure, biliary, pancreatic disease, PEM	Peripheral neuropathy, reduced DTR, impaired balance/gait, myopathy, pigmented retinopathy, RBC fragility (acanthocytes) and haemolysis	Screen if fat malabsorption suspected Vitamin E dosing
Folate	Water soluble vitamin, DNA/RNA synthesis and amino acid metabolism	Green leafy vegetables, fortified bread/cereals	Restricted food access, Methotrexate, phenytoin and sulfasalazine, cotrimoxazole antagonize folate utilization	Restricted food access, lack of fresh food intake	Glossitis, stomatitis, poor growth and fetal neural tube defects, Macrocytic anemia, hypersegmented neutrophils	Screen if clinical deficiency suspected, poor fresh food access, macrocytosis,
K Phytomenadione	Clotting factors 2, 7, 9, 10 protein C and S; cofactor for γ-glutamyl carboxylase	Green leafy vegetables, vegetable oils (especially soy) eggs, meat, dairy	Liver failure	Intestinal failure, biliary, pancreatic disease, PEM	Bleeding/bruising	Not measured, check INR Vitamin K dosing