

**Table 31-4** Characteristics of Trace Mineral Deficiencies

MINERAL	FUNCTION	MANIFESTATIONS OF DEFICIENCY	COMMENTS	SOURCES
Iron	Heme-containing macromolecules (e.g., hemoglobin, cytochrome, and myoglobin)	Anemia, spoon nails, reduced muscle and mental performance	History of pica, cow's milk, gastrointestinal bleeding	Meat, liver, grains, legumes
Copper	Redox reactions (e.g., cytochrome oxidase)	Hypochromic anemia, neutropenia, osteoporosis, hypotonia, hypoproteinemia	Inborn error, Menkes kinky hair syndrome	Liver, nuts, grains, legumes, chocolate
Zinc	Metalloenzymes (e.g., alkaline phosphatase, carbonic anhydrase, DNA polymerase); wound healing	<i>Acrodermatitis enteropathica</i> : poor growth, acro-orificial rash, alopecia, delayed sexual development, hypogeusia, infection	Protein-calorie malnutrition; weaning; malabsorption syndromes	Meat, grains, legumes
Selenium	Antioxidant; glutathione peroxidase	Keshan cardiomyopathy in China	Endemic areas; long-term TPN without Se	Meat, vegetables
Chromium	Insulin cofactor	Poor weight gain, glucose intolerance, neuropathy	Protein-calorie malnutrition, long-term TPN without Cr	Yeast, breads
Fluoride	Strengthening of dental enamel	Caries	Supplementation during tooth growth, narrow therapeutic range, fluorosis may cause staining of the teeth	Seafood, fortified water
Iodine	Thyroxine, triiodothyronine production	Simple endemic goiter <i>Myxedematous cretinism</i> : congenital hypothyroidism <i>Neurologic cretinism</i> : mental retardation, deafness, spasticity, normal thyroxine level at birth	Endemic in New Guinea, the Congo; endemic in Great Lakes area before use of iodized salt	Seafood, iodized salt

TPN, Total parenteral nutrition.

is uncommon. The American Academy of Pediatrics recommends that parenteral vitamin K (0.5 to 1 mg) be given to all newborns shortly after birth.

## MINERALS

The major minerals are those that require intakes of more than 100 mg/day and contribute at least 0.1% of total body weight. There are seven essential major minerals: calcium, phosphorus, magnesium, sodium, potassium, chloride, and sulfur. Ten trace minerals, which constitute less than 0.1% of body weight, have essential physiologic roles. Characteristics of trace mineral deficiencies are listed in [Table 31-4](#).

### Calcium



#### Decision-Making Algorithms

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Hypocalcemia  
Hypercalcemia

Calcium is the most abundant major mineral. Ninety-nine percent of calcium is in the skeleton; the remaining 1% is in extracellular fluids, intracellular compartments, and cell membranes. The nonskeletal calcium has a role in nerve conduction, muscle contraction, blood clotting, and membrane permeability. There are two distinct bone calcium phosphate pools—a large, crystalline form and a smaller, amorphous phase. Bone calcium constantly turns over, with concurrent

bone reabsorption and formation. Approximately half of **bone mineral accretion** occurs during adolescence. Bone mineral density peaks in early adulthood and is influenced by prior and concurrent dietary calcium intake, exercise, and hormone status (testosterone, estrogen).

Calcium intake can come from a variety of sources, with dairy products providing the most common and concentrated source. The calcium equivalent of 1 cup of milk (about 300 mg of calcium) is  $\frac{3}{4}$  cup of plain yogurt, 1.5 oz of cheddar cheese, 2 cups of ice cream,  $\frac{1}{2}$  cup of almonds, or 2.5 oz of sardines. Other sources of calcium include some leafy green vegetables (broccoli, kale, collards); lime-processed tortillas; calcium-precipitated tofu; and calcium-fortified juices, cereals, and breads.

There is no classic calcium deficiency syndrome because blood and cell levels are closely regulated. The body can mobilize skeletal calcium and increase the absorptive efficiency of dietary calcium. **Osteoporosis** that occurs in childhood is related to protein-calorie malnutrition, vitamin C deficiency, steroid therapy, endocrine disorders, immobilization and disuse, osteogenesis imperfecta, or calcium deficiency (in premature infants). It is believed that the primary method of prevention of **postmenopausal osteoporosis** is to ensure maximum peak bone mass by providing optimal calcium intake during childhood and adolescence. Bone mineral status can be monitored by dual-energy x-ray absorptiometry.

No adverse effects are observed in adults with dietary calcium intakes of 2.5 g/day. There is concern that higher intakes may increase the risk of urinary stone formation, constipation, and decreased renal function and may inhibit intestinal absorption of other minerals (iron, zinc).