

Toxicity Acute zinc toxicity after oral ingestion causes nausea, vomiting, and fever. Zinc fumes from welding may also be toxic and cause fever, respiratory distress, excessive salivation, sweating, and headache. Chronic large doses of zinc (ranging from 150 to 450 mg/d) may depress immune function and cause hypochromic anemia as a result of a secondary copper deficiency. Intranasal zinc preparations should be avoided because they may lead to irreversible damage of the nasal mucosa and anosmia.

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Copper is an integral part of numerous enzyme systems, including amine oxidases, ferroxidase (ceruloplasmin), cytochrome c oxidase, superoxide dismutase, and dopamine hydroxylase. Copper is also a component of ferroprotein, a transport protein involved in the basolateral transfer of iron during absorption from the enterocyte. As such, copper plays a role in iron metabolism, melanin synthesis, energy production, neurotransmitter synthesis, and CNS function; the synthesis and cross-linking of elastin and collagen; and the scavenging of superoxide radicals. Dietary sources of copper include shellfish, liver, nuts, legumes, bran, and organ meats.

Deficiency Dietary copper deficiency is relatively rare, although it has been described in premature infants who are fed milk diets and in infants with malabsorption ([Table 333-2](#)). Copper-deficiency anemia (refractory to therapeutic iron) has been reported in patients with malabsorptive diseases and nephrotic syndrome and in patients treated for Wilson's disease with chronic high doses of oral zinc, which can interfere with copper absorption. *Menkes kinky hair syndrome* is an X-linked metabolic disturbance of copper metabolism characterized by intellectual disability, hypocupremia, and decreased circulating ceruloplasmin ([Chap. 413](#)). This syndrome is caused by mutations in the copper-transporting *ATP7A* gene. Children with this disease often die within 5 years because of dissecting aneurysms or cardiac rupture. Aceruloplasminemia is a rare autosomal recessive disease characterized by tissue iron overload, mental deterioration, microcytic anemia, and low serum iron and copper concentrations.