Selenium

Sources and Physiological Functions

Selenium is a trace mineral essential to good health. The major dietary sources of selenium are plant foods. Selenium concentrations in plants generally reflect the concentration of selenium in soils, but some meats and seafood can also contribute dietary selenium; in the United States, meats and bread are common sources. Depending on foodstuff origin, variation in its selenium content can be between 11-fold and 72-fold, so it is difficult to predict dietary intake by relying on estimates from nutrient databases (Keck 2006).

Health Effects

Selenium functions through selenoproteins, several of which are oxidant-defense enzymes. For example, the selenium-dependent glutathione peroxidase defends the body against oxidative stress. Other selenium-associated proteins regulate the action of thyroid hormones and the oxidation-reduction status of vitamin C and other molecules (Institute of Medicine 2000). Most selenium in animal tissues is present as selenomethionine or selenocysteine.

Selenium deficiency in the United States is rare, but it is seen in other countries, most notably in China, where the concentration of selenium in soil is low. In the United States, most people with selenium depletion or deficiency have severe gastrointestinal problems, such as Crohn's disease, or have undergone surgical removal of part of the stomach, which can cause impaired selenium absorption (Kuroki 2003; Rannem 1992; Bjerre 1989).

By itself, selenium deficiency does not usually cause illness, but it can make the body more susceptible to illnesses caused by other nutritional, biochemical, or infectious stresses (Beck 2003). Three specific diseases have been associated with selenium deficiency. Keshan disease occurs only in selenium-deficient children and is associated with an enlarged heart and poor heart function. Kashin-Beck disease is a disorder of the bones and joints of the hands and fingers, elbows, knees, and ankles of children and adolescents. Lastly, myxedematous endemic cretinism, a condition that results in intellectual disability, occurs in infants born to mothers deficient in both selenium and iodine (Institute of Medicine 2000).

Blood concentrations of selenium greater than 1,000 nanograms per milliliter (ng/mL) (12.7 micromoles per liter [µmol/L]) can cause a condition known as selenosis (Koller 1986).

Manifestations of selenosis include gastrointestinal upset, hair loss, blotchy white nails, garlic-breath odor, fatigue, irritability, and mild nerve damage (Goldhaber 2003).

Intake Recommendations

The National Academy of Sciences has established Adequate Intakes (AI) for infants and Recommended Dietary Allowances (RDA) for older age groups for selenium (Institute of Medicine 2000). The AIs reflect the observed mean selenium intake of infants fed principally with human milk. The RDAs are based on the amount needed to maximize synthesis of the selenoprotein glutathione peroxidase, as assessed by the plateau in the activity of the plasma isoform of this enzyme.

Adequate Intakes (AI)

- 15 µg/day for infants ages 0–6 months
- 20 µg/day for infants ages 7–12 months

Recommended Dietary Allowances (RDA)

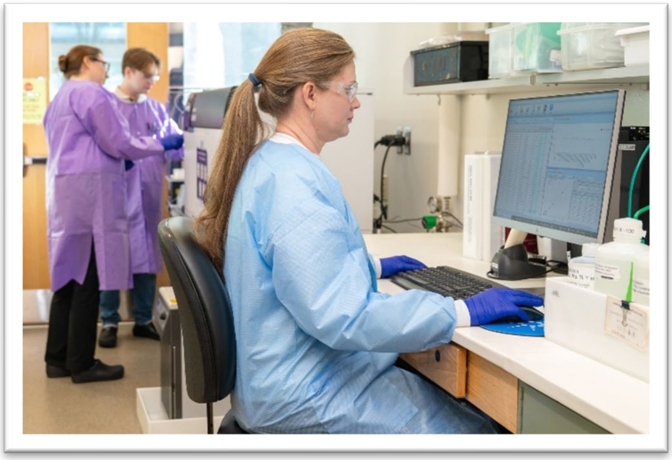
- 20 µg/day for children ages 1–3 years
- 30 µg/day for children ages 4–8 years
- 40 µg/day for children ages 9–13 years
- 55 µg/day for adolescents (ages 14–18 years) and nonpregnant adults
- 60 µg/day for pregnant women
- 70 µg/day during lactation

Biochemical Indicators and Cutoff Values

A diagnosis of selenium deficiency is confirmed by measuring concentrations of selenium in serum or plasma. Values less than 70 ng/mL or 0.8 µmol/L suggest that synthesis of selenium-associated proteins has not yet reached a plateau and that selenium supplies are limited (Institute of Medicine 2000).

Analytical Methods

Serum selenium is often measured using highly specific inductively coupled plasma mass spectrometry (ICP-MS) or atomic absorption spectrometry (AAS). A standard reference material (SRM 1598a Inorganic constituents in animal serum) is available from the National Institute of



Standards and Technology (NIST) with certified values for selenium. The New York State Department of Health's Wadsworth Center, College of American Pathologists, and Center for Toxicology in Quebec (CTQ) offer external quality assessment or proficiency testing programs for metals in biological matrices, which include selenium in serum.

Findings from NHANES

The National Health and Nutrition Examination Survey (NHANES) is the only source for nationally representative data on serum selenium for the U.S. population (Pfeiffer 2026). Researchers found slight differences in serum selenium concentrations measured in the U.S. population in NHANES III (1988–1994) by race-ethnicity, income, and geographic region that may be explained by dietary intake factors (Niskar 2003). The mean and median serum selenium concentrations were 1.58 µmol/L and 1.56 µmol/L, respectively. Serum selenium concentrations differed by age, sex, race, ethnicity, poverty-income ratio, and geographic region. Based on data from *What We Eat in America*, less than 3% of survey participants had a dietary intake of selenium below the EAR in NHANES 2001–2002 (Moshfegh 2005). In NHANES August 2021–August 2023, mean daily intakes of selenium were around 130 µg for adult males, around 100 µg for adult females, and between 73 and 116 µg for children and adolescents (U.S. Department of Agriculture, Agricultural Research Service 2024).

For more information about selenium, see the Institute of Medicine's Dietary Reference Intake report (Institute of Medicine 2000) and fact sheets from the National Institutes of Health, Office of Dietary Supplements (https://ods.od.nih.gov/factsheets/list-VitaminsMinerals/). A narrative review for selenium as part of a broader panel of neglected micronutrients has been published (Brown 2025).

Data in the 2026 tables

Data presented are from univariate analysis that was not adjusted for demographic variables (e.g., age, sex, race and Hispanic origin) or other blood concentration determinants (e.g., dietary intake, supplement use, smoking, BMI). Data for serum selenium were available for children ages 3–11 years from NHANES 1999–2000 and were generated by atomic absorption spectrometry (AAS). Data were also available for participants ages 6 years and older from NHANES 2011–2016 (from a 1/3 sample subset) and were generated by inductively coupled plasma mass spectrometry (ICP-MS). The two methods generated comparable results.

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