

Iodine

Sources and Physiological Functions

Iodine, a trace element found in soil, is an essential component of the thyroid hormones involved in regulating the body's metabolic processes related to normal growth and development. Across the world, iodized salt and seafood are the major dietary sources of iodine. In the United States, where the addition of iodine to salt is not mandatory, most people get their iodine from dairy products and grains (bread) (Murray 2008). In the United States, salt is iodized with potassium iodide at 100 parts per million (76 milligram [mg] of iodine per kilogram [kg] of salt). Iodized salt is chosen by about 50% to 60% of the U.S. population (Institute of Medicine 2001). Still, most ingested salt (approximately 70%) comes from processed food, which is typically not iodized in the United States or in Canada. Dairy products have been identified as another important contributor to iodine status among reproductive-age women in the United States (Perrine 2010).

Health Effects

Iodine nutrition is a growing issue within industrialized countries, including the United States. Part of the problem is changing dietary patterns and food manufacturing practices (Hatch-McChesney 2022), which have caused declining iodine intake. There is a broad spectrum of iodine deficiency disorders, including hypothyroidism, goiter, cretinism, and varying degrees of other growth and developmental abnormalities. Iodine deficiency is the leading preventable cause of intellectual disability in the world (WHO 2007). From 1990 to 2019, the age-standardized rate of developmental intellectual disability attributed to iodine deficiency was 22.54 per 100,000 people (Yang 2024). While there was a small decrease from 1990 to 2019 in the global burden of iodine deficiency (estimated annual percentage rate of -0.69) (Han 2022), 30% of the world's population is still at risk (Andersson 2012; Hatch-McChesney 2022).

Thyroid enlargement (goiter) is usually the earliest clinical feature of iodine deficiency. Thyroid hormone is particularly important in the development of the central nervous system during the fetal and early postnatal periods. Although it is well established that severe iodine deficiency affects thyroid hormone production, no clear association between mild-to-moderate iodine deficiency and thyroid function has been found in a systematic review and meta-analysis (Aarsland 2025). In areas where iodized salt is common, iodine deficiency is rare. The most critical period for iodine

sufficiency is in utero through the first two years of life, when thyroid hormones are required for normal brain development ([WHO 2007](#)).

Excess iodine intake may also cause goiter, as well as hyper- or hypothyroidism. High iodine intake has also been associated with increased risk for thyroid papillary cancer ([Institute of Medicine 2001](#)). For most people, iodine intake from usual foods and supplements is unlikely to exceed the tolerable upper intake level (1100 µg/day) ([Institute of Medicine 2001](#)).

Intake Recommendations

The Institute of Medicine established Adequate Intakes (AI) for infants and Recommended Dietary Allowances (RDA) for older age groups for iodine ([2001](#)):

Adequate Intakes (AI)

- 110 µg per day for infants ages 0–6 months
- 130 µg per day for infants ages 7–12 months

Recommended Dietary Allowances (RDA)

- 90 µg per day for children ages 1–8 years
- 120 µg per day for children ages 9–13 years
- 150 µg per day for adolescents (ages 14–18 years) and nonpregnant adults
- 220 µg per day for pregnant women
- 290 µg per day during lactation

Dietary iodine requirements are higher in pregnancy because of increased thyroid hormone production, increased renal iodine excretion, and fetal iodine requirements ([Glinooer 2007](#)).

WHO recommends a slightly higher iodine intake for pregnant women (250 µg per day) ([WHO 2007](#)).

The American Thyroid Association recommends that North American women receive dietary supplements containing 150 µg iodine daily during pregnancy and lactation and that all prenatal vitamins contain 150 µg of iodine ([Becker 2006](#)). An Endocrine Society Clinical Practice Guideline on the management of thyroid dysfunction during pregnancy and postpartum recommends an average daily intake of 250 µg iodine for pregnant women ([Abalovich 2007](#)). A survey of prenatal multivitamins marketed in the United States showed that 49% did not contain iodine ([Leung 2009](#)). Furthermore, most women of childbearing age (approximately 80%) are not consuming supplements containing iodine ([Gregory 2009](#); [Gahche 2013](#); [Gupta 2018](#)).

Biochemical Indicators and Iodine Status Categories

The Biomarkers of Nutrition for Development (BOND) project published a comprehensive review of iodine biology and biomarkers (Rohner 2014). Most dietary iodine absorbed in the body eventually appears in the urine, so urine iodine excretion is recommended for assessing recent dietary iodine intake worldwide (WHO 2013).

WHO categories for median urine iodine concentrations in school-age children and adults (excluding pregnant and lactating women) are widely used to define iodine intake and nutrition status for populations (WHO 2013). These categories are useful for classifying population risk, but they don't define individual risk for adverse health outcomes. Urine iodine excretion varies day to day, even among individuals with stable iodine intake. But it tends to offset when the sample includes enough people (100–500 spot urine samples per group or subgroup) (Andersen 2008). Separate categories are used for pregnant women, lactating women, and children younger than age 2 years (WHO 2013).

Epidemiologic criteria for assessing iodine nutrition based on median urine iodine concentrations of different target groups (WHO 2013)

Median urine iodine (ng/mL)	Iodine intake	Iodine status
School-age children (≥6 years)*		
<20	Insufficient	Severe iodine deficiency
20–49	Insufficient	Moderate iodine deficiency
50–99	Insufficient	Mild iodine deficiency
100–199	Adequate	Adequate iodine nutrition
200–299	Above requirements	May pose a slight risk of more than adequate intake in these populations
≥300	Excessive	Risk for adverse health consequences (e.g., iodine-induced hyperthyroidism, autoimmune thyroid diseases)
Pregnant women		
<150	Insufficient	
150–249	Adequate	
250–499	Above requirements	

Median urine iodine (ng/mL)	Iodine intake	Iodine status
≥500	Excessive	
Lactating women and children less than 2 years		
<100	Insufficient	
≥100	Adequate	

* Also applies to adults but not to pregnant and lactating women.

Analytical Methods

Urine iodine is often measured with highly specific inductively coupled plasma mass spectrometry (ICP-MS) methods or technically simpler spectrophotometric methods. A two-level standard reference material (SRM 3668 Mercury, perchlorate, and iodine in frozen human urine) is available from the National Institute of Standards and Technology (NIST) with reference values for iodine.



CDC has hosted an external quality assessment program ensuring the quality of urine iodine procedures (EQUIP) since the early 2000s ([Caldwell 2005b](#)). Also, the Center for Toxicology in Quebec (CTQ) offers an external quality assessment program for metals in biological matrices, which includes iodine in urine.

Findings from NHANES

The National Health and Nutrition Examination Survey (NHANES) is the only source for nationally representative data on urine iodine for the U.S. population since 1971 (Pfeiffer 2026a). NHANES III (1988–1994) showed much lower urine iodine concentrations than NHANES I (1971–1974) (Hollowell 1998). Two factors could have affected this decline. In the mid-1980s, the dairy industry tried to reduce the iodine residue in milk from feed supplements and iodophor sanitizing agents. There was also a ban on erythrosine, an iodine-containing dye in fruit-flavored breakfast cereals (Pennington 1996).

After the initial drop between NHANES I to NHANES III, the median urine iodine concentration stabilized in NHANES survey cycles between 2001–2002 and 2009–2010. The overall population ages 6 years and older and nonpregnant women of reproductive age had adequate iodine intake (Caldwell 2005; Caldwell 2008; Caldwell 2011; Caldwell 2013). In NHANES 2005–2008, the median (95% confidence interval) urine iodine concentration for pregnant women [125 (86–198) ng/mL; $n=184$] was below the cutoff value of 150 ng/mL. This indicates iodine deficiency, but the sample was small (Caldwell 2011). In NHANES 2007–2014, pregnant women [144 (120–190) ng/mL] were again insufficient, but nonpregnant women were adequate [119 (111–127) ng/mL] (Perrine 2019). Smoothed reference distribution curves for urine iodine have been developed for specific demographic categories (Pan 2013). After adjusting for demographic changes over time, mean urine iodine concentrations decreased ~25%–30% in persons ≥ 6 y and in women of reproductive age from NHANES 2001–2002 to 2017–2018, with women of reproductive age reaching borderline mild iodine deficiency levels (Pfeiffer 2026b). Dietary iodine intake in U.S. girls and women who participated in NHANES 2011–2020 showed declines in all groups except for pregnant women. A significant decline in milk consumption was likely a major contributor (Sun 2024) and may explain the decreasing urine iodine concentrations. Continued monitoring of the population for iodine sufficiency is warranted because of groups at risk for iodine deficiency disorders.

A multiple regression analysis of NHANES 2003–2006 showed that sociodemographic (age, education, income, race-ethnicity, and sex) and lifestyle (alcohol consumption, body mass index, dietary supplement use, physical activity, and smoking) variables explained 5% of the urine iodine variability and 41% after additionally controlling for urine creatinine (Pfeiffer 2013). Age, sex, and race and Hispanic origin (non-Hispanic Black vs. non-Hispanic White) differentials in urine iodine concentrations observed in crude univariate analysis remained significant after adjusting for

sociodemographic and lifestyle variables (Pfeiffer 2013). Another multiple regression analysis of NHANES 2003–2006 controlled for demographic variables, smoking, supplement use, fasting, inflammation, and renal function. It showed that fasting was associated with significantly higher urine iodine concentrations (26.4%), but inflammation and renal function were not associated (Haynes 2013).

For more information about iodine, see the Institute of Medicine’s Dietary Reference Intake report (Institute of Medicine 2001) and fact sheets from the National Institutes of Health, Office of Dietary Supplements (<https://ods.od.nih.gov/factsheets/list-VitaminsMinerals/>).

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 urine iodine were available for different population subgroups sampled in all NHANES cycles since 2001 and were generated by inductively coupled plasma mass spectrometry (ICP-MS) (Caldwell 2003). The ICP-MS method produced comparable results to the established Sandell-Kolthoff spectrophotometric method used in NHANES III (Pino 1998). Separate tables are presented for raw urine iodine concentrations and for creatinine corrected urine iodine. Data from the 2019–March 2020 cycle are not included because field operations were suspended in March 2020 due to the COVID-19 pandemic and the resulting data were not considered nationally representative. NHANES resumed operations in August 2021 and the most recent cycle concluded in August 2023; however, urine iodine data have not yet been made publicly available.

NHANES cycle	Population subgroup
2001–2002	Persons ages ≥6 years (1/3 sample subset)
2003–2004	Persons ages ≥6 years (1/3 sample subset)
2005–2006	Persons ages ≥6 years (1/3 sample subset)
2007–2008	Persons ages ≥6 years (full sample)
2009–2010	Persons ages ≥6 years (1/3 sample subset)
2011–2012	Persons ages ≥6 years (1/3 sample subset)
2013–2014	Persons ages ≥6 years (1/3 sample subset)
2015–2016	Persons ages ≥3 years (1/3 sample subset)
2017–2018	Persons ages ≥3 years (1/3 sample subset)

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