

Sources of Exposure

Toxicokinetics and Normal Human Levels

Biomarkers/Environmental Levels

ToxGuide™

for

Boron

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U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
www.atsdr.cdc.gov

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General Populations

- The general population may be exposed to borates through ingestion of food and water or insecticides used to control cockroaches, inhalation of boron-containing powders or dusts, or the use of cosmetics, laundry products, or medical preparations containing boron.
- Consumption of fruits and vegetables contribute largely to boron intake in the human diet. The average daily intake is 1 mg. Consumption of wine may contribute an additional 3–4 mg/day.

Occupational Populations

- Workers involved in the manufacture of fiberglass and other glass products, cleaning and laundry products, fertilizers, pesticides, and cosmetics may be exposed to boron compounds.

Toxicokinetics

- Boron is readily absorbed through gastrointestinal system and poorly absorbed through the skin. Boron is also absorbed through the respiratory tract, although the extent of the absorption is not known.
- Boron is widely distributed throughout the body, with the possible exception of fat. At high doses, boron accumulated in the bones.
- Absorbed boron is eliminated principally in the urine in a few days.

Normal Human Levels

- Concentrations of boron in the urine in the general population range from 0.07 to 0.66 mg/100 mL.
- Normal boron blood levels in children and infants range from 0 to 1.25 µg/mL.

Biomarkers

- Blood and urine borate concentrations may be useful biomarkers of exposure.

Environmental Levels

Air

- Levels in ambient air ranged from $<5 \times 10^{-7}$ to 9×10^{-5} mg/m³ with an average concentration of 2×10^{-5} mg/m³.

Sediment and Soil

- Mean concentration of 26 mg/kg in surface soil.

Water

- Average surface water concentration is about 0.1 mg/L, but concentrations vary greatly depending on boron content of local geologic formations. Boron levels in drinking water generally range from <1 to 3 mg/L.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2010. Toxicological Profile for Boron. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

Chemical and Physical Information

Routes of Exposure

Relevance to Public Health (Health Effects)

Boron is a Nonmetal Element

- Boron is a widely occurring nonmetal element occurring mainly in minerals in sediments and sedimentary rock. It is found in the environment primarily combined with oxygen in compounds called borates, and is never found as the free element. Common borate compounds include boric acid, salts of boric acid (e.g., sodium tetraborates, also referred to as borax), and boron oxide.
- The primary use of boron compounds is for the production of glass and ceramics, followed by soaps and detergents, bleaches, agriculture and enamels and glazes.
- Boric acid is used in cosmetics, pharmaceuticals, and toiletries. It is also used to reduce flammability of cellulose insulation, cotton batting in mattresses, and wood composites.
- Boric acid or its sodium salts are the active ingredient in a number of pesticide products.
- Boron oxide is incorporated into cellulose material to inhibit combustion.
- Borates are used in the manufacture of adhesives and are added to lubricants, brake fluids, metalworking fluids, water treatment chemicals, and fuel additives.

- Inhalation – Minor route of exposure for the general population. Predominant route of exposure for boron workers.
- Oral – Predominant route of exposure for the general population via ingestion of boron in food and drinking water.
- Dermal – Minor route of exposure.

Boron in the Environment

- As an element, boron itself cannot be degraded in the environment; however, it may undergo various reactions that change the form of boron.
- Atmospheric boron may be in the form of particulate matter or aerosols as borides, boron oxides, borates, boranes, organoboron compounds, trihalide boron compounds, or borazines.
- The half-life of airborne particles is usually on the order of days, depending on the size of the particle and atmospheric conditions.
- Borates are relatively soluble in water, and are probably removed from the atmosphere by precipitation and dry deposition.
- It is unlikely that boron is bioconcentrated significantly.

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

Minimal Risk Levels (MRLs)

Inhalation

- An MRL of 0.3 mg/m³ has been derived for acute-duration inhalation exposure (≤14 days).
- No intermediate- or chronic-duration inhalation MRLs were derived for boron.

Oral

- An MRL of 0.2 mg boron/kg/day has been derived for acute-duration oral exposure (≤14 days).
- An MRL of 0.2 mg boron/kg/day has been derived for intermediate-duration oral exposure (15–364 days).
- No chronic-duration oral MRL was derived for boron.

Health Effects

- The primary health effects associated with inhalation exposure of humans to boron are acute respiratory and ocular irritation.
- Oral exposure animal studies have clearly identified the reproductive system and developing fetus as the most sensitive targets of boron toxicity.
- DHHS, IARC, and EPA have not classified boron for human carcinogenicity.

Children's Health

- It is not known if children are more susceptible to boron poisoning than adults.