

Sources of Exposure

Toxicokinetics and Biomonitoring

Biomarkers/Environmental Levels

ToxGuide™

for Beryllium Be

CAS# 7440-41-7

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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

General Populations

- The general population is exposed to trace amounts of beryllium by inhalation of contaminated air and ingestion of contaminated drinking water and food. Cigarette smoke may also be a source of beryllium.
- The general population may be exposed to beryllium as a result of coal combustion and solid waste incineration.
- Populations living near some beryllium Superfund sites have contaminated groundwater.

Occupational Populations

- Exposure to beryllium occurs primarily in the workplace.
- Workers in beryllium manufacturing, fabricating, or reclaiming are at higher risk for beryllium exposure.
- Workers' family members may also be exposed to beryllium from contaminated clothing.

Toxicokinetics

- Inhalation is the primary route of beryllium absorption in humans, but data on the rate and extent of absorption of inhaled beryllium in humans are limited.
- Absorbed beryllium is distributed throughout the body. Beryllium first accumulates in the liver, then the lymph nodes and bones. It can be transferred across the placenta.
- Beryllium and its compounds are not biotransformed, but soluble beryllium salts are partially converted to less soluble forms in the lung.
- Beryllium is slowly cleared from the lungs. Beryllium can be excreted via breast milk, feces, and urine.

NHANES Biomonitoring

- Urinary beryllium was measured for the National Health and Nutrition Examination Survey (NHANES) until 2010.
- In the 2009–2010 cycle of NHANES, all values of urinary beryllium that were not missing were below the lower detection limit of 0.072 µg/L.

Biomarkers

- Beryllium in blood, urine, hair, and tissue can be used as biomarkers of exposure.
- A Beryllium Lymphocyte Proliferation Test (BeLPT) draws blood to identify if an individual is sensitized to beryllium.

Environmental Levels

- Air:
 - Outdoor air range of mean levels 0.241–0.283 ng/m³
 - Indoor air ≤0.0045 ng/m³
- Water:
 - Surface water range 0–32.6 µg/L
 - Groundwater range <1–18 µg/L
 - Drinking water range <0.002–2,000 µg/L
- Soil:
 - Range 0.1–2.1 mg/kg
- Food:
 - ≤36 µg/kg fresh weight
- Effluent
 - Range 0–0.08 µg/L

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2023. Toxicological Profile for Beryllium. 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)

Beryllium is a Gray Solid

- Beryllium naturally occurs in the earth's rocks.
- There are approximately 45 mineralized forms of beryllium. The two that are most frequently mined are beryl and bertrandite. Beryl is also well known as the gemstones emerald, aquamarine, and beryl.
- Beryllium exists as a solid and is part of the metal family.
- Beryllium is lightweight and strong, making it ideal for use in the defense, aerospace, energy, and electronics industries. It is also used in the medical and dental fields.
- Some beryllium compounds are soluble in water.

- Inhalation – Inhalation is a primary route of exposure for the general population and workers. Trace amounts of beryllium are present in outdoor air.
- Oral – A minor route of exposure may occur through ingestion of foods that contain beryllium, through ingestion of contaminated water, and through accidental ingestion of contaminated soil.
- Dermal – Dermal contact is a potential route of exposure for workers.

Beryllium in the Environment

- Beryllium is naturally present in rocks, coal, soil, and volcanic dust.
- Beryllium does not degrade in the environment, but it does change form.
- The transport of beryllium in the atmosphere to terrestrial and aquatic surfaces occurs through wet and dry deposition.
- Beryllium is carried to water bodies by the process of land erosion.
- Beryllium is more likely to be present in the sediment or suspended matter in water bodies than in the water.
- Beryllium in air is attached to particulate matter. The residence time depends on the particle size.
- Beryllium is not likely to bioaccumulate in the human food chain.

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

Minimal Risk Levels (MRLs)

Inhalation

- No acute- or intermediate-duration inhalation MRLs were derived for beryllium.
- A chronic-duration (≥ 365 days) inhalation MRL of $0.001 \mu\text{g}/\text{m}^3$ was derived for beryllium.

Oral

- No acute-, intermediate-, or chronic-duration oral MRLs were derived for beryllium.

Health Effects

- Exposure to beryllium can lead to beryllium sensitization, acute beryllium disease, and chronic beryllium disease in humans.
- Acute beryllium disease is characterized by inflammation of the respiratory tract tissues. Symptoms include nasopharyngitis, shortness of breath, labored breathing, and chemical pneumonitis.
- Chronic beryllium disease (CBD) is an immune response to beryllium. Lung granulomas, respiratory symptoms, and impaired lung function have been observed in individuals with CBD.

- Beryllium sensitization is a beryllium-specific cell-mediated immune response. It can occur in individuals who are genetically susceptible to beryllium. It does not cause any physical impairments but does indicate susceptibility to CBD.
- Dermal contact with beryllium may cause skin granulomas or edema. Dermatitis has also been observed in workers exposed to airborne beryllium.
- Effects of oral exposure in humans and animals are not well studied.
- Increases in lung cancer have been observed in some studies of beryllium workers and in studies in animals exposed to airborne beryllium.
- The Department of Health and Human Services (HHS) considers beryllium and beryllium compounds to be known human carcinogens. The U.S. Environmental Protection Agency (EPA) has classified inhaled beryllium as a probable human carcinogen to humans; the carcinogenicity of ingested beryllium cannot be determined. The International Agency for Research on Cancer (IARC) has classified beryllium as a human carcinogen.

Children's Health

- Children exposed to beryllium are expected to experience effects similar to those expected in adults.