THALLIUM - TOXGUIDE™

CHEMICAL, PHYSICAL, AND RADIOLOGICAL INFORMATION

Thallium (Tl) is a naturally occurring trace element found in the earth's crust. In the environment, it is primarily found as the monovalent ion.

Thallium is primarily used in high-temperature superconductors, infrared optical materials, low-melting glasses, photoelectric cells, and gamma radiation detection equipment. Thallium-201 is a radioactive form used medically in the diagnosis of coronary artery disease. Thallium compounds were once used as pesticides for the control of rodents and insects but were banned for this use by the U.S. Environmental Protection Agency (EPA) in 1972.

ENVIRONMENTAL FATE AND DETECTED LEVELS

Air: Based on limited data from 30–40 years ago, thallium levels in air in the United States were typically 0.04 ng/m^3.

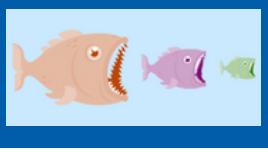
Thallium released into air by industrial processes may exist as thallium oxide, thallium hydroxide, thallium sulfate, or thallium sulfide. Thallium sulfate and thallium hydroxide will likely partition to water vapor.

Water: Thallium levels in groundwater are <1 ppb. It has been detected in drinking water at concentrations as high as 7.2 ppb.

Thallium compounds are generally soluble in water. Thallium may partition from water to soils and sediments.

Sediment and Soil: Thallium levels in most soils range from 0.05 to 5 ppm, with a median level of about 0.5 ppm. Thallium levels in marine sediments are about 0.08–5 mg/kg.

Terrestrial plants can absorb thallium from soil.



Bioconcentration: Thallium compounds tend to bioconcentrate in aquatic plants.

GENERAL POPULATION EXPOSURE

General population exposure to thallium is expected to be low.

Primary route of potential exposure: Oral

- Ingestion of foods, primarily green vegetables

Possible route of potential exposure: Inhalation

- Minor route of exposure for the general population
- Predominant route of occupational exposure

Possible route of potential exposure: Dermal

- Dermal exposure could occur from handling thallium-containing compounds, soil, ores, limestone, or cement.

POPULATIONS WITH POTENTIALLY HIGH EXPOSURE

Compared to the general population, the following groups may also have increased risk of exposure:

- Populations living near industrial releases or contaminated hazardous waste sites (via ambient air and/or groundwater contamination).
- Workers at smelters, power plants, cement factories, and other industries that produce or use thallium compounds or alloys.

THALLIUM

BIOMARKERS

Primary: Thallium can be measured in blood, urine, and hair.

Thallium levels in blood are considered to be reflective of recent exposures, as thallium is rapidly cleared from the blood.

BIOMONITORING LEVELS

Geometric mean urinary thallium levels (NHANES 2017–2018): 0.179 µg/g creatinine.

Urinary thallium levels in the general population have remained fairly stable over time (NHANES 1999–2018).

TOXICOKINETICS

Absorption: Thallium is likely absorbed through the lungs, although quantitative estimates have not been identified. It is well absorbed following oral exposure; one study estimated 100% absorption.

Distribution: Absorbed thallium is widely distributed throughout the body, with the highest concentrations in the kidneys.

Metabolism: Thallium is not metabolized.

Excretion: Thallium is primarily excreted in the urine, with lesser amounts excreted in feces.

HEALTH EFFECTS

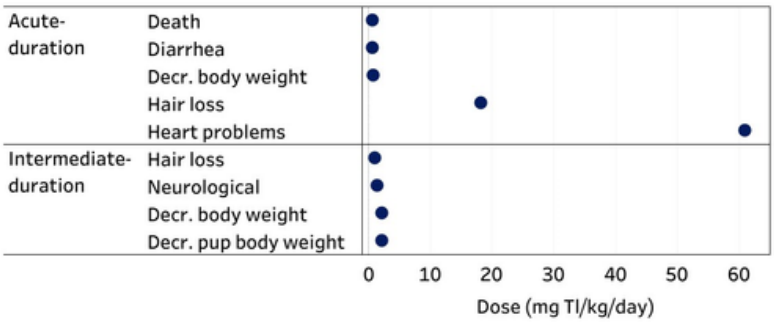
The health effects of thallium in humans have been widely reported in cases of poisoned individuals. The most commonly reported effects include tingling and numbness and increased sensitivity to pain in the hands and feet; hair loss; abdominal pain, nausea/vomiting, and diarrhea or constipation; and tachycardia, hypertension, and electrocardiogram (EKG) alterations.

There are limited animal toxicity data. Oral studies have consistently reported hair loss. Other effects that have been observed in animal studies include tachycardia and bradycardia, diarrhea, decreased nerve action potentials, and death.

Decreased pup body weight and pup hair loss have also been observed in oral exposure studies in animals.

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

Sensitive Effects of Oral Exposure to Thallium in Animals



MINIMAL RISK LEVELS (MRLs)

Acute: ≤14 days; Intermediate: 15–364 days; Chronic: ≥365 days

Inhalation: No inhalation MRLs were derived for any duration.

Oral: No oral MRLs were derived for any duration.

CANCER

The EPA concluded that the database for thallium provides inadequate information to assess carcinogenic potential. The Department of Health and Human Services (HHS) and the International Agency for Research on Cancer (IARC) have not evaluated the carcinogenicity of thallium.

REFERENCE

Agency for Toxic Substances and Disease Registry (ATSDR). 2024. Toxicological profile for thallium (draft for public comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services. https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=309&tid=49.