

Sources of Exposure

Toxicokinetics and Normal Human Levels

Biomarkers/Environmental Levels

ToxGuide™

for

Nickel

Ni

CAS# 7440-02-0

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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 nickel in ambient air, food, and water.
- General populations may also be exposed through inhalation of cigarette smoke.
- Widespread exposure may occur through dermal contact with coins and jewelry containing nickel alloys or nickel plating.

Occupational Populations

- Occupational exposure to nickel may occur by dermal contact or by inhalation of aerosols, dusts, fumes, or mists containing nickel. Dermal contact may also occur with nickel solutions, such as those used in electroplating.
- Occupational exposure to nickel will be highest for those involved in production, processing, and use of nickel. Operations with the highest airborne concentrations of nickel are those involved in grinding, welding, and handling powders.

Toxicokinetics

- In humans, about 20–35% of inhaled nickel deposited in the lungs is absorbed into the bloodstream. About 27% of nickel in drinking water is absorbed in humans; much less nickel (about 1%) is absorbed from food. More soluble nickel compounds have higher absorption efficiencies. Nickel is poorly absorbed through the skin.
- Once absorbed, nickel is distributed throughout the body.
- Nickel is not metabolized and absorbed nickel is eliminated via the urine. The elimination half-time for absorbed nickel is 28 days for the oral route.

Normal Human Levels

- The reference values for nickel in healthy adults are 0.2 µg/L in serum and 1–3 µg/L in urine.

Biomarkers

- Serum and urine nickel levels are the most useful biomarkers of nickel exposure.

Environmental Levels

Air

- Average concentration in ambient air in the contiguous U.S. has been estimated to be 2.22 ng/m³.

Sediment and Soil

- Nickel is a natural constituent of soil and levels vary depending on local geology and anthropogenic input. Typical concentrations range from 4 to 80 ppm.

Water

- Median nickel concentrations in rivers and lakes range from 0.5 to 6 µg/L. Similar levels are found in groundwater.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological Profile for Nickel. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Ni

Chemical and Physical Information

Routes of Exposure

Relevance to Public Health (Health Effects)

Nickel is a metal

- Pure nickel is a hard, silvery-white metal.
- It occurs naturally in soils and volcanic dust.
- Nickel combines with other metals to form alloys used for coins, jewelry, and stainless steel.
- Nickel compounds are used for electroplating, to color ceramics, and in battery production.

- Inhalation (breathing) – Minor route of exposure for the general population. Predominant route of exposure for nickel workers.
- Oral (mouth) – The predominant route of exposure to nickel is via ingestion of food. The general population may also be exposed to nickel in drinking water.
- Dermal – Exposure to nickel in nickel alloys and nickel-plated materials including steel, coins, and jewelry.

Nickel in the Environment

- Atmospheric nickel aerosols are removed by gravitational settling and dry and wet deposition. Submicron particles have an atmospheric half-life as long as 30 days.
- Adsorption of nickel onto suspended particles in water is one of primary removal mechanisms of nickel from the water column.
- Nickel is strongly adsorbed by soil.
- It is unlikely that nickel 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

- No acute-duration inhalation MRL was derived for nickel (≤ 14 days).
- An MRL of 0.0002 mg Ni/m³ has been derived for intermediate-duration inhalation exposure (15–364 days).
- An MRL of 0.00009 mg Ni/m³ has been derived for chronic-duration inhalation exposure (≥ 1 year).

Oral

- No oral MRLs were derived for nickel.

Health Effects

Contact dermatitis

- The most commonly reported adverse health effect associated with nickel exposure is contact dermatitis.
- After an individual is sensitized to nickel, dermal contact with small amount of nickel or oral exposure to fairly low doses can result in dermatitis.
- Approximately 10–20% of the general population is sensitized to nickel.

Health Effects (continued)

Respiratory

- Lung inflammation is the predominant noncancerous respiratory effect.
- The toxicity of nickel in the respiratory tract appears to be related to solubility of the individual nickel compounds with soluble nickel compounds being the most toxic.
- Atrophy of the nasal epithelium has been observed following exposure to soluble nickel compounds.
- Nickel compounds are considered human carcinogens and metallic nickel is possibly a human carcinogen.

Developmental Effects

- Decreased survival has been observed in the offspring of rats exposed to nickel in drinking water.

Children's Health

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