

Sources of Exposure

Toxicokinetics and Biomonitoring

Biomarkers/Environmental Levels

General Populations

- The most important source of exposure to acrylonitrile for the general population is use of products containing acrylonitrile, such as acrylic fiber clothing or carpeting, and acrylonitrile-based plastics.
- Acrylonitrile may enter food materials by leaching from plastic food containers.
- Cigarette and marijuana smoke may be a source of acrylonitrile exposure for smokers.

Occupational Populations

- Workers in facilities that manufacture or use acrylonitrile are expected to be exposed to higher than background levels of acrylonitrile.

Toxicokinetics

- Approximately 50% of inhaled acrylonitrile and 90% of ingested acrylonitrile are absorbed.
- Acrylonitrile is widely distributed throughout the body, with higher levels in the liver, kidneys, lungs, and stomach.
- The primary metabolic pathway is conjugation with glutathione. It is also metabolized to form 2-cyanoethylene, which is metabolized to thiocyanate or thiodiglycolic acid.
- Acrylonitrile is primarily excreted in the urine as conjugates or thiocyanate. A small percentage is excreted in air as carbon dioxide.

NHANES Biomonitoring

The acrylonitrile metabolite, N-acetyl-S-s(2-cyanoethyl)-L-cysteine (2-CyEMA) is used as a biomarker of exposure. The geometric mean urinary level (creatinine adjusted) in survey years 2015–2016 was 2.82 µg/g creatinine.

Biomarkers

- Levels of acrylonitrile can be measured in blood and urine. Levels of the metabolites, thiocyanate and 2CyEMA, are also used as biomarkers of exposure.

Environmental Levels

Air

- The average ambient air level of acrylonitrile in samples taken from 63 location in the United States in 2020–2022 was 0.01 ppbv.

Water

- Acrylonitrile was not detected in 87 surface water samples collected in 2020–2022. It was detected in one of the 1,121 groundwater samples collected in 2020–2022, at a concentration of 1.82 ppb.

Sediment and Soil

- Acrylonitrile was not detected in 97 sediment samples collected between 2000 and 2009.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2023. Toxicological Profile for Acrylonitrile (Draft for Public Comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

ToxGuide™ for Acrylonitrile



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U.S. Department of Health and
Human Services
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Agency for Toxic Substances
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Chemical and Physical Information

Routes of Exposure

Relevance to Public Health (Health Effects)

Acrylonitrile is a liquid

- Acrylonitrile is a volatile substance used in the manufacture of acrylic fibers, plastics, and other chemicals.
- Acrylonitrile is readily volatile and significant quantities may escape into air during manufacture and use. It is readily soluble in water.

- Inhalation – Likely route of exposure for the general population through the use of products containing acrylonitrile; primary route of exposure for occupational population.
- Oral – Likely route of exposure for the general population through ingestion of acrylonitrile leached from plastic food containers.
- Dermal – Minor route of exposure for the general and occupational populations.

Acrylonitrile in the Environment

- In air, acrylonitrile is degraded primarily by reaction with hydroxyl radicals, with an estimated half-life of 1.2–12 hours.
- In water, acrylonitrile has little tendency to adsorb to sediment, but is subject to biodegradation by microorganisms.
- Acrylonitrile is expected to be highly mobile in soils.

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 chronic-duration inhalation MRLs were derived for acrylonitrile.
- A provisional intermediate-duration (15–364 days) inhalation MRL of 0.0009 ppm was derived for acrylonitrile.

Oral

- A provisional acute-duration (≤ 14 days) oral MRL of 0.09 mg/kg/day was derived for acrylonitrile.
- A provisional intermediate-duration (15–364 days) oral MRL of 0.02 mg/kg/day was derived for acrylonitrile.
- A chronic-duration (≥ 365 days) oral MRL of 0.00009 (9×10^{-5}) mg/kg/day was derived for acrylonitrile.

Health Effects

- Humans exposed to high levels of acrylonitrile via inhalation exposure reported respiratory tract irritation and clinical signs associated with cyanide poisoning, including labored and irregular breathing, dizziness, cyanosis, limb weakness, and convulsions.

Health Effects (*cont'd*)

- Respiratory irritation has also been observed in laboratory animals acutely exposed to high levels of acrylonitrile. Longer term inhalation exposure has resulted in nasal cavity epithelial lesions in animals.
- Lesions in the non-glandular stomach have been reported in laboratory animals following oral exposure.
- Signs of overt neurotoxicity, including hindlimb weakness, decreased activity, paralysis, and seizures, have been observed in laboratory animals. Other neurological effects included decreased nerve conduction velocity and glial cell tumors in the brain.
- Decreased fetal body weights and increased malformations have been observed in animals following inhalation and oral exposure.
- The Department of Health and Human Services (HHS) has categorized acrylonitrile as reasonably anticipated to be a human carcinogen. The U.S. Environmental Protection Agency (EPA) has categorized acrylonitrile as a probable human carcinogen. The International Agency for Research on Cancer (IARC) concluded that acrylonitrile is possibly carcinogenic to humans.

Children's Health

- It is not known if children are more sensitive to the toxicity of acrylonitrile than adults.