Sources of Exposure

General Populations

- Exposure to nitrobenzene may occur through contaminated air, water, or soil as a result of releases from industrial sources.
- General exposure of the population to nitrobenzene is limited to variable concentrations in air and possibly drinking water.
- Levels of nitrobenzene in air may be higher near manufacturing facilities, especially petroleum refineries, leather finishing facilities, and some chemical manufacturers.

Occupational Populations

- Occupational exposure can be significantly higher than the exposure of the general population.
- Occupational exposure is most likely to occur through inhalation or dermal contact.
- Nitrobenzene is readily absorbed through the skin and lungs. Workers that may be exposed to this chemical should wear personal protective equipment.
- Populations working in explosive, pharmaceutical, aniline, pesticide, and dye-stuff manufacturing are at a higher risk of exposure to nitrobenzene.

Toxicokinetics and Biomonitoring

Toxicokinetics

- Nitrobenzene may be absorbed after oral, inhalation, or dermal exposure.
- Nitrobenzene is believed to be widely distributed throughout the body after absorption. There is indication that nitrobenzene is lipophilic and therefore is easily absorbed by fatty tissues.
- Nitrobenzene undergoes metabolism through reduction and oxidation reactions. The metabolites of nitrobenzene, including aniline, are likely associated with many toxicological effects.
- Urinary excretion is the main route of removal of nitrobenzene from the body.

NHANES Biomonitoring

- Nitrobenzene in blood is measured in the U.S. National Health and Nutrition Examination Survey. However, the prevalence of nitrobenzene in blood is below the detection limit of 0.320 ng/mL for all demographics (NHANES 2011-2016).

Biomarkers/Environmental Levels

Biomarkers

Nitrobenzene in the blood is indicative of recent exposure. Urinalysis of metabolites including p-nitrophenol and p-aminophenol can also be used to indicate potential exposure to nitrobenzene. However, these metabolites are not specific to nitrobenzene.

Environmental Levels

- Air:
  - Range 0.02–14.48 ppb
- Water:
  - Municipal wastewater effluent range 10-20 ppb
- Soil:
  - Limited measurements exist, but a concentration of 8 ppm was detected in soil at one sampling site.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2022. Toxicological Profile for Nitrobenzene (Draft for Public Comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

ToxGuide™ for Nitrobenzene

$C_6H_5NO_2$

CAS# 98-95-3

April 2022

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

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Chemical and Physical Information

Nitrobenzene is found either in crystal form or as an oily liquid

- Nitrobenzene is colorless to pale yellow.
- Nitrobenzene is a synthetic chemical, and it does not occur naturally in the environment.
- It is sparingly soluble in water and most organic solvents.
- Nitrobenzene is volatile and flammable.

Routes of Exposure

- Inhalation – Inhalation exposure from nitrobenzene released into the atmosphere or volatilized from water may occur near hazardous waste sites or near industries where nitrobenzene is released. Inhalation is a primary route of exposure for the general population and workers.
- Oral – Exposure may occur through ingestion of contaminated water, but this is less likely than inhalation or dermal exposure.
- Dermal – Dermal contact is a potential route of exposure for workers. Nitrobenzene is readily absorbed through the skin.

Nitrobenzene in the Environment

- Nitrobenzene exists in the atmosphere as a vapor. The half-life of nitrobenzene in air has been estimated as 115 days.
- In water, photolysis and biodegradation are significant degradation pathways. The half-life of nitrobenzene in water has been estimated as 17 hours to 6 days. Nitrobenzene does not hydrolyze.
- Nitrobenzene is likely to migrate through the soil and into groundwater.
- Once in the environment, nitrobenzene may be degraded by atmospheric photochemical decomposition in air, and by direct photolysis or by biodegradation mediated by microorganisms found in sediment, soils, and water.
- Nitrobenzene is not likely to bioaccumulate in fish or other aquatic species.

Relevance to Public Health (Health Effects)

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

Minimal Risk Levels (MRLs)

Inhalation

- An acute-duration (≤14 days) inhalation MRL of 0.04 ppm was derived for nitrobenzene.
- An intermediate-duration (15-364 days) inhalation MRL of 0.003 ppm was derived for nitrobenzene.
- A chronic-duration (≥365 days) inhalation MRL of 0.001 ppm was derived for nitrobenzene.

Oral

- No chronic-duration oral MRL was derived for nitrobenzene.
- An acute-duration oral MRL of 0.05 mg/kg/day was derived for nitrobenzene.
- An intermediate-duration oral MRL of 0.02 mg/kg/day was derived for nitrobenzene.

Health Effects

- The main target of nitrobenzene toxicity is the hematologic system. Nitrobenzene may increase methemoglobin in the blood. Methemoglobin is not capable of releasing oxygen to tissues in the body. At high levels of methemoglobin (>60%), stupor and respiratory distress are present and immediate treatment is needed. A key indicator of increased methemoglobin is cyanosis.

Health Effects

- Respiratory effects have been observed in animal studies. Specifically, chronic exposure to nitrobenzene has resulted in bronchiolization of the alveoli and degeneration of the olfactory epithelium.
- There is limited evidence that the liver is a target for nitrobenzene toxicity in humans. However, animal studies have demonstrated that nitrobenzene may adversely affect the liver.
- Animal studies show that kidneys may also be a target for nitrobenzene toxicity.
- Nitrobenzene is a known male reproductive toxicant based on animal studies. These effects occur at higher levels than the hematological and respiratory effects observed with nitrobenzene exposure.
- The National Toxicology Program has determined that nitrobenzene is reasonably anticipated to be a human carcinogen (causing cancer).
- The U.S. Environmental Protection Agency has classified nitrobenzene as a likely human carcinogen.
- The International Agency for Research on Cancer has determined that nitrobenzene is possibly carcinogenic to humans.

Children's Health

- In the first six months of life there is increased risk of methemoglobinemia. Older children would be expected to experience similar effects as adults.