

Sources of Exposure

Toxicokinetics and Normal Human Levels

Biomarkers/Environmental Levels

General Populations

- DDT (dichlorodiphenyltrichloroethane) is an organochlorine insecticide that was banned in the United States and many parts of the world in 1972.
- DDE (dichlorodiphenyldichloroethylene) and DDD (dichlorodiphenyldichloroethane) are degradation products and metabolites of DDT.
- The general population can be exposed to DDT and its metabolites through consumption of contaminated foods from areas where DDT is still used, or that contain bioaccumulated residues (meat, fish, poultry, dairy products).
- Inhalation of ambient air and ingestion of drinking water are not considered major exposure pathways to the general population.

Occupational Populations

- Occupational exposure should be negligible, except in areas where DDT remains in use. Workers involved in mobilization of DDT (site remediation) may be exposed to DDT or its metabolites.

Toxicokinetics

- DDT, DDE, and DDD are absorbed following inhalation, oral, or dermal exposure, but humans are predominantly exposed via the oral route.
- DDT, DDE, and DDD are readily distributed in the lymph and blood to all body tissues and ultimately stored in proportion to the lipid content of the tissue, regardless of the route of exposure.
- Metabolism of DDT is similar in humans, rats, mice, and hamsters. The stable metabolite, *p,p'*-DDE, is found at higher tissue concentrations than DDT and DDD isomers, and DDA [2,2-bis(4-chlorophenyl)acetic acid] is the major urinary metabolite.
- Excretion of DDT in the form of its metabolites is largely via the urine, but DDT excretion also may occur via feces and breast milk. The excretion of DDT is slow, and DDT and DDE may persist in the human body for decades after exposure.

NHANES Biomonitoring

- The geometric mean for DDT levels could not be calculated for serum or lipid samples due to the proportion of results that were below level of detection (7.8 ng/g) (2003–2004).
- The geometric means for DDE levels in the population were 1.5 ng/g in serum and 238 ng/g in lipids (2003–2004).

Biomarkers

- Levels of DDT, DDE, and DDD in serum, blood, or breast milk are the most widely used biomarkers of exposure.
- Hair analysis has also been shown to be a reliable biomarker for exposure to DDT and its metabolites.

Environmental Levels

Air

- There are no recent monitoring data for national levels of DDT, DDE, or DDD in the air in the United States.

Water

- DDT, DDE, and DDD were infrequently detected in 1,092 water samples collected from 2015 to 2017 in EPA's STORET database. The maximum level was 0.005 µg/L for DDT from samples collected in California.

Sediment and Soil

- There are no recent monitoring data for national levels of DDT, DDE, or DDD in the soil or sediment in the United States.

Reference

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

ToxGuide™ for DDT, DDE, and DDD



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Chemical and Physical Information

Routes of Exposure

Relevance to Public Health (Health Effects)

DDT, DDE, and DDD are Solids

- Technical-grade DDT, the grade used for the insecticide, contained 65–80% active form of DDT, 15–21% inactive form of DDT, up to 4% DDD and 1.5% 1-(p-chloro-phenyl)-2,2,2-trichlorethanol.
- Technical DDT is a white amorphous powder that melts over the range of 80–94°C.
- DDE and DDD are both degradation products and metabolites of DDT. DDE has no commercial use.
- DDT use as a pesticide to control insects in agriculture and insects that carry diseases, such as malaria, was banned in 1972 in the United States due to damage to wildlife, persistence in the environment, and concerns regarding potential adverse health effects in humans. It is, however, still used in other countries.
- DDD was also manufactured and used as an insecticide, but to a lesser degree than DDT. It is banned for this use. DDD has been used medically to treat cancer of the adrenal gland.

- Inhalation – Not a likely route of exposure for the general and occupational populations.
- Oral – Most likely route of exposure for the general population is through ingestion of contaminated foodstuffs.
- Dermal – Not likely an exposure route of concern for the general and occupational populations.

DDT, DDE, and DDD in the Environment

- DDT and its metabolites are very persistent and bioaccumulate in the environment.
- DDT, DDE, and DDD enter the atmosphere as a result of volatilization from water and moist soil surfaces.
- These chemicals can undergo long-range global transport due to repeated deposition/volatilization.
- DDT, DDE, and DDD adsorb strongly to soil and are only slightly soluble in water; therefore, leaching into lower soil layers and groundwater is minimal.
- In soil, DDT will break down to DDE and DDD by microorganisms. Depending on soil type, the DDT half-life is 2–15 years.
- In water, DDT adsorbs strongly to particulate matter and primarily partitions into the sediment.
- Lipophilic properties and long half-lives of DDT, DDE, and DDD are responsible for their high bioconcentration in aquatic organisms.

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-, intermediate-, or chronic duration inhalation MRLs were derived for DDT, DDE, or DDD.

Oral

- An acute-duration (≤ 14 days) oral MRL of 0.0005 mg/kg/day was derived for DDT, DDE, and DDD.
- An intermediate-duration (15–364 days) oral MRL of 0.0005 mg/kg/day was derived for DDT, DDE, and DDD.
- A chronic-duration (≥ 365 days) oral MRL of 0.0005 mg/kg/day was derived for DDT, DDE, and DDD.

Health Effects

- The nervous system appears to be a primary target for acute, high-dose DDT toxicity, with the potential to produce reversible perspiration, headache, nausea convulsions, and tremors. These effects were not seen in humans exposed to a lower dose for 18 months.
- Serum levels of DDT, DDE, or DDD have been associated with an increased risk for abortion or premature delivery, prevalence for wheeze in infant or child offspring (exposed *in utero*), and prevalence of Type 2 diabetes mellitus.
- Animals exposed orally to DDT, DDE, or DDD experienced neurological (tremors), neurodevelopmental, liver, reproductive, developmental, and immunological effects.
- Case-control studies showed increased risk of liver cancer with increased serum DDT levels. The Department of Health and Human Services (HHS) determined that DDT is “reasonably anticipated to be a human carcinogen,” the U.S. Environmental Protection Agency (EPA) Integrated Risk Information System (IRIS) classified DDT, DDD, and DDE (in 1988), each as a “probable human carcinogen” (Group B2), and the International Agency for Research on Cancer (IARC) determined that DDT is “probably carcinogenic to humans.”

Children’s Health

- It is not known if children are more sensitive to DDT, DDE, or DDD exposure than adults.