

Environmental Fact Sheet



Birth Defect Research for Children

Dioxin

What are Dioxins?

Dioxins are a family of polychlorinated dibenzo-p-dioxin compounds that are found everywhere in the environment, generally at low levels. These large, complex molecules do not easily biodegrade and are extremely persistent. The most toxic and readily found is 2,3,7,8-tetrachlorodibenzo-p-dioxin commonly known as TCDD. In addition, there are certain dioxin-like substances, brominated and chlorinated dibenzofurans (CDFs), and certain polychlorinated biphenyl (PCBs) that appear to have similar toxic effects. There are 219 possible chlorinated dibenzodioxins (CDDs) and dibenzofurans.



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What are they used for?

Dioxins do not occur naturally in the environment, but are unintended results of human activity. The main source is the combustion of chlorinated chemicals. Dioxins can be formed in the manufacture of chlorophenols and phenoxy herbicides, in the chlorine bleaching process of paper, and in incineration of organic waste containing chlorine products. The largest sources of dioxin discharge into the environment are factories that make polyvinyl chloride (PVC) products, and incinerators burning chlorine waste.

Adverse Human Health Effects:

The major route of human exposure is ingestion of dioxin-contaminated foods. According to the US EPA, 38 percent of total exposure to dioxin in the US comes from eating beef; 24.1 percent from dairy products other than milk; 17.6 percent from milk; and a total of 37 percent divided among chicken, pork, fish and eggs.

Acute Health Effects:

TCDD is the most toxic of the dioxin compounds tested in experimental animals. Humans, however, are not exposed to pure TCDD. Combinations with other associated chemicals may contribute to the human dioxin toxicity. Acute levels produce eye irritation, headaches, nausea and vomiting, severe muscle pain, elevated liver enzyme levels, gross enlargement of the liver, pancreatitis, chloracne, neurobehavioral effects, persistently elevated blood lipids, and a possible increased risk of death from heart attack or coronary artery disease.

Suppression of the immune system, withering of the thymus gland, and a wasting syndrome have been produced in experimental animals. There is no known no-effect dose of dioxins.

Chronic Effects:

Repeated exposure produces cumulative toxicity. Since dioxins are fat-soluble, they bioaccumulate and move up from smaller to larger organisms in the food chain. Levels in fish can be 100,000 times that of the surrounding water. Bioaccumulation continues in human fat cells, because dioxins have an elimination half-life (the time it takes the body to eliminate one-half of its accumulation) in mammals of approximately 7 to 10 years. The US EPA estimates that the average US citizen without any direct exposure to dioxins other than a routine diet has a average body burden of 13 nanograms of dioxin per kilogram of body weight (ng/kg), or parts per trillion (ppt), and the level increases with age. Dioxin has been found in the sperm of Vietnam veterans 20 years after exposure.

Reproductive Effects:

Dioxins have been found to disrupt the balance of the endocrine system. These and other adverse effects have been found at body burden levels (levels that have accumulated in our bodies) very near the US average. EPA estimates that 5 percent of Americans, approximately 12.5 million people, have body burdens twice the average. Dioxins cross the placenta, concentrate in the fetus, and are suspected of causing reproductive effects. Those effects include complications of pregnancy, such as

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spontaneous abortion. Birth defects include abnormal development of the germ layer in the early embryo. The germ layer forms the central nervous system and sense organs. Other defects are developmental and growth retardation, skeletal, cardiovascular, central nervous system (CNS) malformations, decreased sperm quality, and feminization. Decreased male hormones were reported in an occupational setting at 1.3 times the average, and sperm loss and endometriosis in monkeys and rats at 5 times the US average body burden. Learning disorders have been reported in young monkeys with dioxin body burdens as low as 42 ppt, or 3.2 times the US average. Dioxins are excreted in breast milk and nursing infants are at high-risk for exposure because of their immature central nervous and immune systems. Studies have shown immune system toxicity in monkeys at 10 ppt, 25 percent below the average US body burden.

The US EPA has known about the toxicity of dioxins since the 1970s, but did little to address the problem until they published a 9-volume peer-reviewed draft assessment in 1994. Chapter 9 reaches a consensus that dioxin probably causes cancer in wildlife and humans, and it harms the immune system and the reproductive systems in fish, birds, and mammals, including humans, at doses that are miniscule. Only part of the final report has been issued. Dr. Peter Hauser from the Baltimore Veterans Affairs Medical Center published an article that reviewed a number of studies on the reproductive outcome in humans of prenatal exposures to dioxins and dioxin-like chemicals. These studies reported children with increases in learning and attention disorders and ectodermal problems.

Genetic effects:

Although dioxins are not believed to be directly genetically toxic, they can bind to certain genetic receptors in a manner that can promote conditions favorable to gene mutations.

Carcinogenic Effects:

Dioxins are probable human carcinogens. Evidence is strong for an association with soft tissue sarcomas. Hodgkin's disease and non-Hodgkin's lymphoma are more closely linked with exposure to chlorophenoxy herbicides that are contaminated with dioxins during manufacture. There is also evidence linking dioxins to respiratory and prostate cancer and multiple myeloma. Increased incidents of thyroid and breast cancer, and increased deaths from stomach and brain cancer have been reported. Studies in humans have shown that the risk of cancer rises significantly when the body burden reaches 109 ppt, approximately 8 times the current US average. Public health policy usually aims to keep the public's exposure to poisons at least 100 times below levels known to harm humans or animals. Because of their acutely lethal effects in experimental animals, and from their role as probable human and animal carcinogens, TCDD and other dioxins are EPA Class 3 for general toxicity: may cause irreversible effects which can be life-threatening.

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