

FACT SHEET: Dioxins and dioxin-like substances

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What are dioxins and dioxin-like substances, and what are common sources for these substances?

Dioxins and dioxin-like substances are a family of chemicals that are created by combustion processes as simple as burning wood for a campfire. They are found everywhere in the environment naturally, but they are also formed as a byproduct of industrial processes. Some specific dioxins, such as polychlorinated biphenyls (PCBs) are only known to be formed by manmade activity. As modern manufacturing methods have improved and out of an abundance of caution, dioxins and dioxin-like substances have been all but eliminated from industrial processes and equipment. Remedial actions taken in the US over the past 40 years have reduced the amount of dioxins and dioxin like substances in environment to about 10% of the levels seen in the 1970s (World Health Organization, 2010).

How can I be exposed to dioxins and dioxin-like substances?

Because dioxins are everywhere, some dioxin exposure is unavoidable. Dioxins are found naturally in the air, soil, water and the foods we eat. Even before birth we are exposed to dioxins that pass from our mother's body through the placenta. As infants we are exposed to low levels of dioxins in breast milk and baby formula. In fact, over 90% of the dioxins we are exposed to on a daily basis are from food sources. The highest amounts are in animal products such as beef, poultry, fish, and milk, especially those high in fat. They are also present in much lower quantities in fruits and vegetables. Dioxins are also found in cigarette smoke and car exhaust. The table to the right shows typical sources of dioxin exposure. Note that the units are in picograms (pg); that is, one trillionth of a gram-a very small amount. So small in fact, the average human red blood cell weighs 27 pg. (World Health Organization, 2010) (Schechter, et al., 2001)

Exposure source	Dioxin Amount (pg)
Water (daily exposure)	0.005
Contact with soil (child's average daily exposure)	0.6
Air (daily exposure)	4.2
Vegetables (1 serving; 100g)	8.6
Cigarette smoke (1 cigarette)	12.9
Cheese (1 slice)	13.2
Egg (1 Large)	20.6
Butter (1 fl oz)	33.0
Milk (8 fl oz)	37.9
Chicken (4 oz)	38.0
Ocean fish (4 oz)	44.3
Pork (4 oz)	44.5
Beef (4 oz)	45.1
Hot dogs (4 oz)	58.2
Ice cream (1 cup)	98.4
Breast milk (8 fl oz)	99.4
Freshwater fish (4 oz)	196.1

What are the environmental standards for dioxin contamination in soil?

When a site has been contaminated with man-made dioxins, the site must be cleaned up until the amount of dioxins in the soil is below 1,000 pg TEQ/g. This is the standard set by both the U.S. Environmental Protection Agency and the Japanese government. If the amount of dioxin is below this level, no action is required. A few countries have even stricter guidelines, based on use. Germany for example requires that playgrounds for children be cleaned to less than 100 pg TEQ/g. The soil at the Kadena soccer field (58 pg TEQ/g) meets even this very cautious German standard (Environmental Protection Agency, 2003) (Tokyo Metropolitan Government, 2007) (European Commission DG Environment, 1999).

Sources: (Schechter, et al., 2001), (California Department of Health Services, 2003), (Muto & Takazawa, 1989)

What are the health effects of dioxin exposure? Do dioxins cause cancer?

Extremely high levels of dioxin exposure can cause a skin condition known as chloracne. No other human health effects have been proven. However, because laboratory studies suggest that dioxins have the potential to affect the immune, endocrine, reproductive and nervous systems, regulations have been put in place to minimize the public's exposure until more is known (Agency for Toxic Substances and Disease Registry, 1999) (World Health Organization, 2010) (Tuomisto, Vartiainen, & Tuomisto, 2011).

2,3,7,8-tetrachlorodibenzodioxin (TCDD), the most toxic dioxin, has been confirmed to cause cancer in some animals. However, many studies of workers and communities exposed to TCDD from industrial accidents show weak connections between exposure to TCDD and an increased risk of cancer. Even so, as a precaution TCDD is classified as a "suspected" human carcinogen (Cole, Trichopoulos, Pastides, Starr, & Mandel, 2003).

There is limited data available that defines a safe level of exposure or the level in the air that will cause harmful effects. The Occupational Safety and Health Administration (OSHA) has not issued an exposure limit for workers routinely exposed to dioxins as part of their job. Dioxins are rarely found alone and the presence of other chemicals in higher levels can cause health effects of their own. This makes it extremely difficult to isolate the health effects contributable to dioxins and the doses at which they occur (Environmental Protection Agency, 2003).

Can I get tested to see if I have been exposed to the barrels found at the Okinawa City soccer field near Kadena Air Base?

While dioxin can be detected in the body, there is no test your doctor can do that will help them counsel you about your exposure to dioxin and any possible health risks. No "normal," "safe" or "unsafe" level of dioxins in the blood or body tissues has been determined, and baseline levels vary considerably from person to person (California Department of Health Services, 2003).

What is the level of dioxin at the Okinawa City soccer field site near Kadena Air Base?

Dioxins exist in soils throughout the world in varying levels based on location. In rural areas, dioxin levels are lower and typical found at levels less than 5 pg TEQ/g. In urban areas, dioxin levels are higher ranging from 10-30 pg TEQ/g. Areas in close proximity to incinerators, major highways, and other sources of dioxin production can be higher. The table on the right shows levels of dioxins present in the soil at various urban locations around the world to include two sites with known contamination. The site near Kadena Air Base is provided for comparison. The levels found in the soil by two independent agencies were 52 and 58 pg TEQ/g. An isolated soil sample in direct contact with one of the barrels was measured at 340 pg TEQ/g. All soil samples found are well within environmental standards. These levels are consistent with background levels in other urban areas. The slightly higher elevated level may be attributed to the area sitting between two major highways. A media report indicated that a sample was as high as 840% of the environmental soil standard; however, this was a misinterpretation and misrepresentation of the data. The sample in question was an analysis of the residue on the drum and not of soil at the site. There is no environmental standard to compare levels of residue on a drum to; therefore, it did not exceed any environmental standards (Environmental Protection Agency, 2003).

Location	Concentration (pg TEQ/g)
Seattle, Washington	19
Canada/U.S.	22
United Kingdom	28
Western Germany	38
Tokyo, Japan	43
Site near Kadena Air Base	58
Midwestern U.S.	67
Midland, Michigan (Residential)	158*
Times Beach, Missouri (1982)	127,000
Da Nang, Vietnam	365,000

*Midland, Michigan is the home of DOW Chemical headquarters and a significant dioxin source in the U.S. This value is not representative of background dioxin levels in urban areas in the U.S.

Sources: (Environmental Protection Agency, 2003), (Department of Ecology; State of Washington, 2011), (Sakurai, et al., 2000), (Environmental Protection Agency, 2012), (The Aspen Institute, 2011)

Is the Kadena Air Base drinking water safe? There are reports stating the dioxin levels at the site are well above standards.

The drinking water on Kadena Air Base is safe and is routinely tested for dioxins and many other harmful contaminants. The dioxin levels were undetectable (<5 pg/L) which is well below the EPA drinking water standards of 30 pg/L. Current water treatment methods are highly effective at removing dioxins and detection of dioxins in drinking water is very rare. These standards apply to the water coming directly out of the tap in your home, not for water under the ground. Additionally, the groundwater under the soccer field is not used for drinking water. The Kadena Air Base drinking water system is a closed loop system that is operated under pressure, preventing hazardous chemicals from entering the drinking water (18th Medical Group, Bioenvironmental Engineering, 2013) (Environmental Protection Agency, 2013).

How do I get my child's medical record documented for dioxin exposure?

The evidence to date suggests that an exposure has not occurred as all sample results surrounding Kadena Air Base are within environmental guidelines and consistent with background levels. As mentioned previously, your child is exposed to higher levels of dioxins through their diet than the soils near their school. If it is determined that a significant exposure has occurred, environmental health professionals will work with your medical providers to ensure any exposure is properly documented.

How do I reduce my exposure to dioxins?

The best way to reduce exposure to dioxins is to practice a healthy lifestyle. This includes eating lean meats, low fat or skim milk, increased servings of fruits and vegetable, and eliminating exposure to cigarette smoke (World Health Organization, 2010) (California Department of Health Services, 2003).

What is Agent Orange and how is it related to dioxins?

Agent Orange gets its name from the distinctive orange stripe placed around the barrels it was shipped in. It was an herbicide or "weed killer" used during the Vietnam War to destroy enemy crops and clear large areas of vegetation, eliminating cover for North Vietnamese guerilla forces. Agent Orange was actually a 50:50 mixture of two separate herbicides, 2,4-D and 2,4,5-T. The first, 2,4-D is still commercially available world-wide today and is commonly used in agriculture in the US and Japan. The second, 2,4,5-T was once used world-wide as well until it was discovered to be contaminated with dioxin byproducts. Agricultural use of 2,4,5-T was not fully discontinued until the 1980's. The dioxins present in commercially available 2,4,5-T were also a contaminant in Agent Orange (Institute of Medicine, 1994).

Where can I find more information?

- World Health Organization (WHO) - http://www.who.int/ipcs/assessment/public_health/dioxins/en/
- Agency for Toxic Substances and Disease Registry (ATSDR) - <http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=63>
- Environmental Protection Agency (EPA) - <http://cfpub.epa.gov/ncea/CFM/nceaQFind.cfm?keyword=Dioxin>

For questions regarding this fact sheet, please contact Kadena Public Affairs at 18wg.pa@kadena.af.mil.

References

- 18th Medical Group, Bioenvironmental Engineering. (2013). *Consumer Confidence Report (CCR); 2012 Water Quality Report, Kadena and Munitions Storage Area*. Kadena AB, Okinawa, Japan. Retrieved from <http://www.kadena.af.mil/library/communitynotes.asp>
- Agency for Toxic Substances and Disease Registry. (1999, February). Chlorinated Dibenzo-p-dioxins (CDDs). Atlanta, GA. Retrieved from <http://www.atsdr.cdc.gov/toxfaq.html>
- California Department of Health Services. (2003, May). *Dioxins: Technical Information for California Health Officials*. Retrieved from <http://www.ehib.org/papers/Dioxin.pdf>
- Cole, P., Trichopoulos, D., Pastides, H., Starr, T., & Mandel, J. S. (2003, December). Dioxin and cancer: a critical review. *Regulatory Toxicology and Pharmacology*, 38(3), 378-388. Retrieved from <http://www.sciencedirect.com/science/article/pii/S027323000300103X>
- Department of Ecology; State of Washington. (2011). *Urban Seattle Area Soil Dioxin*. Olympia, WA. Retrieved from www.ecy.wa.gov/biblio/1109049.html
- Environmental Protection Agency. (2003). *Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds*. Washington, DC. Retrieved from <http://www.epa.gov/ncea/pdfs/dioxin/nas-review/>
- Environmental Protection Agency. (2012, November). *NPL Site Narrative for Times Beach*. Retrieved from <http://www.epa.gov/superfund/sites/npl/nar833.htm>
- Environmental Protection Agency. (2013, December). *Basic Information about Dioxin (2,3,7,8-TCDD) in Drinking Water*. Retrieved from <http://water.epa.gov/drink/contaminants/basicinformation/dioxin-2-3-7-8-tcdd.cfm#four>
- European Commission DG Environment. (1999). *Compilation of EU Dioxin Exposure and Health Data*. Retrieved from <http://ec.europa.eu/environment/dioxin/pdf/dioxin.pdf>
- Institute of Medicine. (1994). *Veterans and Agent Orange: Health Effects of Herbicides Used in Vietnam*. Washington, D.C.: National Academy Press. Retrieved from <http://books.google.com/books?id=2YQTHJlt5l4C&pg=PA90#v=onepage&q&f=false>
- Muto, H., & Takazawa, Y. (1989). Dioxins in cigarette smoke. *Archives of Environmental Health*(171), 44-46.
- Sakurai, T., Kim, J.-G., Suzuki, N., Matsuo, T., Li, D.-Q., Yao, Y., . . . Nakanishi, J. (2000). Polychlorinated dibenzo-p-dioxins and dibenzofurans in sediment, soil, fish, shellfish and crab samples from Tokyo Bay are, Japan. *Chemosphere*(40), 627-640.
- Schechter, A., Cramer, P., Boggess, K., Stanley, J., Papke, O., Olson, J., . . . Schmitz, M. (2001). Intake of dioxins and related compounds from food in the U.S. population. *Journal of Toxicology and Environmental Health*(63), 1-18. Retrieved from <http://www.ejnet.org/dioxin/dioxininfood.pdf>
- The Aspen Institute. (2011, August). *Hot Spots: Cleaning Up Dioxin-Contaminated Soils*. Retrieved from <http://www.aspeninstitute.org/policy-work/agent-orange/cleaning-dioxin-contaminated-soils>
- Tokyo Metropolitan Government. (2007). *Countermeasures against Soil and Groundwater Contamination*. Tokyo: Environment of Tokyo. Retrieved from http://www.kankyo.metro.tokyo.jp/en/attachement/HighRes_68-71%20%E5%9C%9F%E5%A3%8C%E3%83%BB%E5%9C%B0%E4%B8%8B%E6%B0%B4%E6%B1%9A%E6%9F%93%E5%AF%BE%E7%AD%96.pdf
- Tuomisto, J., Vartiainen, T., & Tuomisto, J. T. (2011). *Synopsis on Dioxins and PCBs*. Helsinki, Finland: National Institute for Health and Welfare.
- World Health Organization. (2010, May). *Dioxins and their effects on human health*. Retrieved from <http://www.who.int/mediacentre/factsheets/fs225/en/index.html>
- World Health Organization. (2010). Exposure to dioxins and dioxin-like substances: a major public health concern. Geneva, Switzerland. Retrieved from <http://www.who.int/entity/ipcs/features/dioxins.pdf>