

# Thyroid Hormone Fact Sheet

Some environmental chemicals can disrupt the thyroid hormone, which is essential for the development of the brain and other organs in fetuses and children. It is also important for the general functioning of the body. These facts point to the need to take prudent actions to identify those at risk for thyroid problems and avoid exposure to these chemicals.

## Background and Science

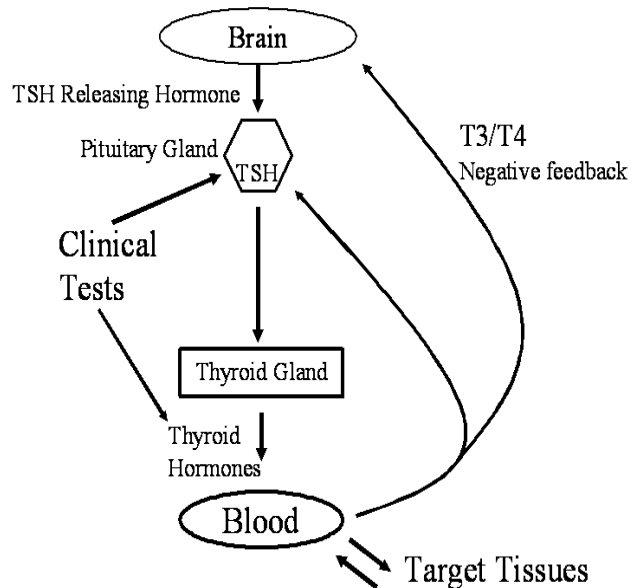
Thyroid hormones control the body's metabolism (lethargy, body temperature, weight), the division of cells, plus aspects of child development. For example, thyroid hormone is essential for fetal brain development in humans and in animals.

The thyroid gland requires iodine to produce the two main thyroid hormones, T4 and T3, which carry four and three iodine atoms, respectively. Thyroid hormones travel in the bloodstream and then enter cells. They work by binding to thyroid receptors (TRs) in the cell nucleus, which then tell the cell's machinery to perform some specific function. T3 is the form of thyroid hormone that is hormonally active and stimulates cell metabolism.

The pituitary gland releases thyroid stimulating hormone, or TSH, to prompt the thyroid gland to produce more thyroid hormone. If the pituitary perceives there is not enough thyroid hormone in the body, TSH levels rise. Conversely, when the thyroid gland releases T4, it suppresses the pituitary's further release of TSH.

## Health Effects and Scope of the Problem

Researchers have concluded that during the brain's development, different parts of the brain are sensitive to the level of thyroid hormone at different points in time. Thus, a thyroid-hormone deficiency may lead to different outcomes at different points during development. The consequences of insufficient thyroid hormone in a young child will be different than in a fetus because different parts of the brain are developing at these stages of life.



During critical stages of fetal brain development, even short-term deficits of thyroid hormone may cause lasting changes to the young brain's structure and cognitive function, with the exact nature and severity of the cognitive deficit dependent on when and how far thyroid hormone levels in the mother have dropped. Even a mild drop in normal thyroid hormone levels during pregnancy can result in measurable harm to the fetus. Research indicates that children born in these circumstances will have lower IQ on average as well as higher rates of attention deficit disorders.

Unfortunately, scientists cannot yet tell us exactly how far thyroid hormone levels must decline in pregnant women before adverse effects can be anticipated in their infants.

## Environmental Chemicals and Thyroid Hormone

Environmental chemicals may disrupt thyroid function via diverse mechanisms.

Some toxic chemicals reduce circulating levels of thyroid hormone in the blood, while others bind directly to thyroid receptors in cells, interfering with the ability of thyroid hormone to transmit its intended "message" to target cells. In studies in both animals and humans, thyroid receptors have been shown to play an important role in turning "on" or "off" genes that tell a cell what to do.

Existing science indicates that perchlorate, PCBs, and bisphenol A, among other environmental pollutants, may have these hormone-disrupting effects, even at the low levels at which they are found in the environment.

**Perchlorate** is a chemical used as a rocket fuel ingredient. It now contaminates many military sites as well as large numbers of drinking water supplies throughout the United States. By inhibiting the thyroid gland's uptake of iodide (without which it cannot make thyroid hormone), ammonium perchlorate directly impacts levels of thyroid hormone in the body. While perchlorate has undergone intensive study, the exact implication for widespread perchlorate pollution on the development of neonates remains unknown.

**Polychlorinated biphenyls (PCBs)** are chlorinated organic compounds used as industrial insulators and lubricants. They are extremely persistent and – despite being phased out of production – remain in fish, breast milk, human serum and other tissues today. PCBs have been associated with neurological impairment, such as reduced psychomotor development, reduced IQ scores, behavioral problems and even mental retardation. PCBs likely have complex effects on the thyroid system, from reducing blood levels of thyroid hormone to affecting the way thyroid hormone works in tissues.

**Bisphenol A** is the first environmental pollutant shown to bind to thyroid receptors. Over 1.7 billion pounds are produced annually in the U.S. It is widely used in manufacturing polycarbonate plastics, such as those found in many water bottles, epoxy resins that coat food cans, and dental sealants often used in children.

Unfortunately, we currently lack the tools and ability to recognize if perchlorate, PCBs, bisphenol A and other environmental pollutants are affecting individual thyroid function, resulting in disruption of brain development and other critical functions. Scientifically, the single most important issue is to determine to what extent thyroid hormone levels must decline before adverse effects are observed and whether this

differs for chemicals that exert antithyroidal effects by different mechanisms. Research is urgently needed to address these issues.

### **Helpful Actions to Take**

**Women** who are pregnant or seeking to become pregnant are neither screened nor given routine advice with respect to assessing their thyroid function. Of 4 million children born in the United States each year, nearly 3 percent (or about 120,000) are born to women who have relatively low levels of T4 in their serum, and/or have marginally elevated levels of TSH (indicating insufficient levels of thyroid hormone). Because thyroid screening is not currently considered part of prenatal care, a woman must request it from her health-care provider.

**Health-care providers** should consider routine screening of women of childbearing age for thyroid function.

**Everyone** can take individual action to ensure adequate dietary intake of iodine. Iodized salt, seafood, kelp and some dairy products are rich in iodine. Kosher or sea salt is not iodized.

### **For More Information**

Information in this fact sheet is from these sources:

1. Zoeller RT. Thyroid hormone and brain development: environmental influences. *Current Opinion in Endocrinology & Diabetes*. 2005 February; 12(1):31-35,
2. Zoeller RT. Research opportunities/needs: thyroid hormone and brain development [document on the Internet]. Freeland, WA: Institute for Children's Environmental Health c2004 [cited 2005 Oct 29]. Available from: [www.iceh.org/pdfs/LDDI/2004NIHMeeting/ZoellerLDDI.pdf](http://www.iceh.org/pdfs/LDDI/2004NIHMeeting/ZoellerLDDI.pdf)
3. Patandin S, Lanting CI, Mulder PG, et al. Effects of environmental exposure to polychlorinated biphenyls and dioxins on cognitive abilities in Dutch children at 42 months of age. *Journal of Pediatrics* 1999; 134(1):33-41.

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This fact sheet was prepared in November 2005 by the Institute for Children's Environmental Health. For more information, please visit [www.iceh.org](http://www.iceh.org)

