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How Environmental Toxins Harm the Thyroid

by Chris Kresser, Kresser Institute | September 6, 2017
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The prevalence of thyroid disease has skyrocketed within the past few decades. According to the American Thyroid Association, an estimated 20 million Americans have some form of thyroid disease.[1] This alarming trend begs the question—what is responsible for the epidemic of thyroid dysfunction? A growing body of research indicates that exposure to environmental toxins is a key piece of the thyroid disease puzzle. Read on to learn about the types of toxins that are harmful to the thyroid and how you can help your patients minimize their toxic exposures and protect their thyroid health.

What types of toxins affect the thyroid?

The thyroid is a small but vitally important endocrine gland located in the base of the neck. It releases a steady stream of hormones that are intrinsically involved in the regulation of metabolism, as well as endocrine, cardiovascular, neurological, and immune function. ***Despite the powerful role the thyroid plays in the body, it is quite susceptible to damage from exogenous influences such as environmental toxins.*** This is due in part to the fact that several categories of environmental toxins bear a structural similarity to thyroid hormones. In addition, the thyroid gland has a naturally high affinity for halogens and metals. While this affinity is intended to draw iodine (a halogen) and selenium (a metalloid) into the thyroid for the production and metabolism of thyroid hormones, it can also lead to the accumulation of harmful halogens and metals within the gland.

The types of toxins that affect the thyroid are thus primarily substances that mimic thyroid hormone structure, contain halogens, or are heavy metals. These toxins can be divided into four main groups based on their source:

1. industrial chemicals,
2. pesticides and herbicides,
3. toxins in consumer goods,
4. and heavy metals.

Are environmental toxins contributing to the epidemic of thyroid disease? #thyroid #thyroidhealth

Industrial chemicals impair thyroid function

Environmental pollution is increasing at a worrying rate worldwide. Three of the most common industrial pollutants are:

1. perchlorate,
2. *polychlorinated biphenyls (PCBs),*
3. *and dioxin*.

These three pollutants ***have been found to significantly disrupt thyroid function***.

Perchlorate is a highly reactive compound that is primarily man-made; small amounts of perchlorate occur naturally in the soil of arid environments, but the contribution of these to environmental contamination is minimal. Perchlorate is widely used in military applications, including rocket fuel and explosives, as well as in the production of leather, rubber, paint, and batteries. ***Perchlorate accumulates in surface water, groundwater, soil, and food grown in contaminated soil***. Drinking water, grains, produce, and dairy products from animals raised on contaminated soil may contain elevated levels of perchlorate.[2]

The thyroid gland is the primary target of perchlorate toxicity in humans.[3] *Urinary perchlorate levels, which are representative of the body's burden of perchlorate, are associated with decreased thyroxine (T4) and increased thyroid-stimulating hormone (TSH).*[4] *Research also indicates that perchlorate can disrupt thyroid function at both high and low doses, overturning the commonly held belief in toxicology that "the dose makes the poison.*[5] ***Perchlorate contains chlorine, which is a halogen with the same ionic charge as iodine. Perchlorate thus disrupts thyroid function by competing with iodide, an essential component of T4, for uptake by the thyroid gland****. This results in reduced thyroid hormone production. Research indicates that low iodine increases one's vulnerability to the effects of perchlorate. Conversely, a greater intake of iodine may help protect the thyroid from the disruptive effects of perchlorate.*[6, 7]

Polychlorinated biphenyls, or PCBs, are another group of industrial toxins that have ***harmful effects on the thyroid***. These man-made chemicals are resistant to temperature and pressure and have thus been used in electrical equipment, as lubricants, and in the production of plastics, adhesives, and paints. Despite being banned in the United States in 1979, PCBs continue to resist degradation and persist in the environment.

Research indicates that PCBs disrupt thyroid function through a variety of mechanisms. They suppress the production of the thyroid hormone receptor, reducing the number of receptors with which thyroid hormone can bind in the body.[8] PCBs bind to thyroid transport proteins, decreasing circulating T4, and impair liver enzymes responsible for converting T4 to T3.[9, 10, 11] PCBs have also been found to raise thyroid antibody levels and promote enlargement of the thyroid gland.[12, 13] The presence of chlorine (a halogen) in PCBs, as well as the structural similarity between PCBs and thyroid hormone, helps to explain the broad spectrum of effects that PCBs have on the thyroid.

Like perchlorate and PCBs, dioxin is a byproduct of manufacturing processes, including pesticide and plastic production. ***Dioxin exposure at levels considered standard in the United States has been associated with decreased T4 and reduced thyroid function, with females more significantly affected than males***.[14] Dioxin mimics thyroid hormone structure and appears to decrease T4 by binding to cell receptors that enhance glucuronidation, a biochemical process that facilitates the excretion of hormones from the body.

Pesticides and herbicides induce hypothyroidism

Pesticides and herbicides are another group of highly prevalent environmental toxins that adversely affect thyroid function. Exposure to organochlorine pesticides, the herbicide paraquat, and the fungicides benomyl and maneb/mancozeb has been associated with an increased incidence of

hypothyroidism in women.[15] The use of a wide variety of other pesticides, including organophosphates and carbamates, has been associated with hypothyroidism in men.[16] ***Pesticides and herbicides disrupt thyroid function by interfering with thyroid hormone gene expression, inhibiting the thyroid's uptake of iodine, binding to thyroid hormone transport proteins, reducing cellular uptake of thyroid hormone, and increasing thyroid hormone clearance from the body***.[17, 18]

Toxins in common household products harm the thyroid

Ideally, a person's home should be their haven, a safe retreat from the outside world. However, modern-day homes can unfortunately contain a plethora of toxins, some of which have a significant impact on the thyroid. Flame retardants, known in the scientific literature as polybrominated diphenyl ethers (PBDEs), are one class of toxins found in consumer goods that may harm the thyroid. They are found in items such as computer and TV screens, furniture, carpet padding, and synthetic textiles. PBDEs contain bromine, a halogen, and thus have a predilection for the thyroid. ***Flame retardants disrupt thyroid function by mimicking the structure of thyroid hormone; they displace T4 from thyroid hormone-binding proteins, preventing T4 from being transported in the blood. They also compete with T4 for thyroid hormone receptor binding sites and disrupt estrogen activity***. This unique interaction may make postmenopausal women especially susceptible to the thyroid-disrupting effects of PBDEs.[19, 20]

Plastics are ubiquitous in our homes, appearing in items such as food storage containers, water bottles, personal care products, and children's toys. ***Many plasticizers, such as BPA and phthalates, mimic the structures of natural hormones and thus have a disruptive effect on the endocrine system, including thyroid function.*** Bisphenol A (BPA), found in food-can linings and plastic bottles, has been found to alter thyroid structure and act as an antagonist to T3 at thyroid hormone receptors.[21, 22] Phthalates, used in vinyl flooring, adhesives, plastics, and as emollients in personal care products, also disrupt thyroid function by inhibiting the binding of thyroid hormone to its receptors.[23]

Finally, two more common household toxins that disrupt thyroid function are the antibacterial chemical triclosan, found in products such as liquid hand soap, and PFOA, used in non-stick cookware and stain-resistant fabrics. ***Animal studies suggest that triclosan and PFOA decrease T4, ultimately lowering thyroid function***.[24, 25, 26]

Heavy metals: Not a friend to the thyroid

Heavy metals are pervasive in our environment, and research continues to emerge demonstrating their harmful effects on human health. ***The heavy metals with the most significant impact on thyroid function are cadmium, lead, mercury, and aluminum.***

Cadmium is a heavy metal that is released into the environment through mining and smelting and is also ubiquitous in phosphate fertilizers, sewage sludge, batteries, pigments, and plastics. ***Chronic cadmium exposure has been found to precipitate multinodular goiter, reduce the secretion of thyroglobulin, and initiate thyroid cell hyperplasia, which may lead to thyroid cancer***.[27, 28]

The contamination of our environment with lead, another toxic heavy metal, has increased substantially due to industrialization, mining, and the previous use of lead in gasoline. Lead is also found in paint in older homes, inexpensive metal jewelry, and children's toys. ***Occupational exposure to lead has been associated with depressed thyroid function and elevated TSH***.[29] Lead may alter thyroid function by causing deiodination of T4. While it is not clear whether current lead exposure levels experienced by the U.S. population adversely affect thyroid function, it is important that we remain aware of the potential thyroid health risks posed by this heavy metal.[30]

Finally, mercury and aluminum exposure are inversely associated with thyroid hormone levels. Common sources of mercury exposure include dental amalgams, seafood, and pollution from coal-burning power plants. Sources of aluminum include antacids, body care products such as deodorant, food additives, vaccines, and aluminum-based cookware. ***Mercury accumulates in the thyroid and reduces iodide uptake, thus inhibiting thyroid hormone production***.[31] ***Animal studies indicate that aluminum oxidatively damages the thyroid, which subsequently affects iodide uptake and thyroid hormone production***.[32] Aluminum also triggers an immune response that can lead to the production of antibodies, some of which may target the thyroid.[33]

Tips for reducing exposure to thyroid-disrupting toxins

While environmental toxins are ubiquitous, there are many ways in which we can help our patients reduce their exposure to these chemicals and ultimately protect and improve their thyroid health.

- ***Make sure your patients have optimal levels of iodine and selenium***. Optimal iodine and selenium intake has been found to attenuate the toxic effects that heavy metals and perchlorate can have on the thyroid.

- ***Encourage your patients to purchase a high-quality water filter for their drinking and bathing water; municipal tap water can be a significant source of toxins***. However, a water pitcher filter is not enough if one hopes to remove as many toxins as possible. Reverse-osmosis filters, on the other hand, have been found to effectively remove perchlorate, pesticides, PCBs, plastics, and a wide variety of heavy metals.

- ***Recommend that your patients eat organic food as much as possible***. This will help them avoid excessive pesticide and herbicide exposure. ***They should also be encouraged to cease using pesticides in their homes and yards***.

- ***Encourage your patients to stop using synthetic antibacterial products and to limit their use of plastics at home***. If they still choose to use some plastic products, recommend that they look for "BPA-free" options. However, keep in mind that BPA-free products may still contain other bisphenol derivatives with potential thyroid-disrupting effects, so it really may be best to entirely avoid drinking from or storing food in plastic containers.

- ***Recommend that your patients stop using non-stick cookware***. PFOA from non-stick cookware can leach into food and is subsequently ingested. Suggest that they use stainless steel or enameled cast iron cookware instead.

If you are interested in learning more about the health impacts of environmental toxins and what factors influence one's susceptibility to toxins, check out my previous article ***"Environmental Toxins: The Elephant in the Room?"*** For more information on how you can help your patients reduce their toxic exposures, check out my article **"Environmental Toxins: Steps for Decreasing Exposure and Increasing Detoxification."**

Now I want to hear from you! Have you observed a relationship between environmental toxin exposure and thyroid health in your patients? What steps have you recommended your patients take to reduce their toxic exposures? Let me know in the comments below.

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CATEGORIES
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ADDITIONAL NOTES:

Teratogen: Any agent that can disturb the development of an embryo or fetus. Teratogens may cause a birth defect in the child. Or a teratogen may halt the pregnancy outright.

Requested paper from Italy

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Treatment with levothyroxin in subclinical hypothyroidism is associated with increased mortality in the elderly☆

Alon Grossman, Ilan Feldhamer, Joseph Meyerovitch
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Carcinogenic junk science is finding it's way into the courtroom

https://www.washingtonexaminer.com/opinion/op-eds/carcinogenic-junk-science-is-finding-its-way-into-the-courtroom

Assistant Professor Jelena Janjic, a pain researcher at Duquesne University in Pittsburgh, is exploring nanotechnology to deliver non-opioid pain medications directly into cells.

https://www.npr.org/sections/health-shots/2018/09/05/636860122/inspired-by-her-own-pain-a-researcher-explores-alternatives-to-opioid-treatments