



# Autism, Environment and Diet: Questions and Answers

## **Q: What causes autism?**

**A:** There is no one cause of autism. Multiple factors in our food and broader environment combine with inherited factors to contribute to autism. All of these factors can play different roles, and can take on various levels of significance in different individuals—all of us are unique in our susceptibility to diseases and disorders, like autism.

In the real world, we are exposed to a complex equation of factors that can ultimately influence our health. As Harvard pediatric neurologist Martha Herbert, M.D. puts it, there is an important difference between “cause” and “risk.” It isn’t even appropriate to talk about a “cause” of autism. Instead, it is more fitting to talk about multiple, interactive risks in our broader environment that may accumulate and contribute to autism. In any child, these environmental factors have the potential to modify the genetic susceptibility she or he is born with.

## **Q: Is there scientific evidence that environmental toxins contribute to autism?**

**A:** Increased risk for autism and autistic behaviors from prenatal and early-life exposures to toxic chemicals has been documented by the following studies.

- **POLLUTION.** Living near a pollution site or near an EPA Superfund site.<sup>1,2</sup> Hazardous air pollutants, including metals and chlorinated solvents.<sup>3</sup> Maternal residence near a freeway.<sup>4</sup>
- **PESTICIDES.** Residence near agricultural organochlorine pesticide (OP) applications.<sup>5</sup> Prenatal exposure to the OP pesticide chlorpyrifos.<sup>6</sup> Exposure to OPs is associated with vitamin D deficiency, providing a clue to a possible contributing dietary factor.<sup>7</sup> There are several plausible physiological mechanisms for the effects of pesticides on abnormal brain development, including

autism. Many pesticides can cause excitation and dysregulation of neural signaling in the brain due to inhibition of acetylcholinesterase and disruption of neural receptors, called GABAs.<sup>8</sup>

- **HEAVY METALS.** Exposure to environmental neurotoxins including mercury, aluminum, lead and cadmium.<sup>9,10,11,12,13,14,15</sup> There is evidence of the biological plausibility of mercury in autism. Mercury disrupts sulfur metabolism, which leads to oxidative stress, commonly elevated in people with autism. This analysis is complicated by and informed by the fact that individuals have varying sensitivity to mercury. Thus, the interaction of genetic (ability to detoxify) and environmental factors (mercury exposure) may be of significance in autism.<sup>16</sup>

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## Q: Is there evidence that diet plays a role in autism?

A: There is a growing and complex body of science linking autism risk to dietary factors. Diet is an important factor in immune health, helping the body fight off the effects of toxic exposures. For example, children exposed to lead who are well-nourished absorb less lead into their bodies than poorly nourished children. Exposure is routine via the food supply to toxins that persist in the environment, and bio-accumulate in the food chain. Meats, fish and dairy products commonly contain PCBs, dioxins, mercury, pesticides, brominated flame retardants and perfluorinated chemicals (PFCs). Novel ingredients introduced to the food supply via food processing, such as mercury in high fructose corn syrup or synthetic food dyes, may provide additional routes of exposure to toxins.<sup>17</sup> Chemicals in food packaging and cookware, like bisphenol A (BPA), phthalates and PFCs, also provide routine exposures to toxins.

Both animal and human studies support the critical role of maternal diet and metabolic status in programming brain circuitry that regulates behavior. A diet high in fat and obesity during pregnancy may make offspring more susceptible to behavior disorders such as ADHD and autism.<sup>18</sup> Metabolic abnormalities linked to mitochondrial dysfunction may play a role in the etiology of autism and vulnerability to oxidative stress, induced by many environmental toxins.<sup>19</sup> Certain bacteria in the gut may play a role in the regressive form of autism.<sup>20</sup>

Gastrointestinal (GI) disorders and metabolic conditions are common in children with autism.<sup>21</sup> Immune abnormalities, including inflammation of the intestinal track and increased intestinal permeability, or “gut leak,” have been reported in children with autism. Alterations in serotonin, which send signals to the gut, may be implicated in some GI dysfunctions.<sup>22</sup> One small study found that participants with autism were more likely to be overweight,

have high intake of foods containing gluten and casein and were more likely than controls to have intestinal dysfunctions.<sup>23</sup>

## Q: Can dietary interventions help people with autism?

A: Parents and clinicians of many children with autism report improvement in behavior and symptoms through specific dietary regimens, including dairy-free and gluten-free diets. Dr. Martha Herbert documents successful dietary, environmental and behavioral interventions based on individualized needs that improve or eliminate autistic behaviors in some individuals.<sup>24, 25</sup> Other published studies examining the effects of dietary interventions on autism report mixed results.<sup>26, 27, 28, 29, 30</sup> The lack of a consensus on the effects of various dietary interventions may be due to the fact that such studies can't possibly account for differences in individual dietary needs.

## Q: How do diet, environment and genes interact in autism?

A: Dr. Herbert and other researchers, including Dr. Russell Blaylock, are now hypothesizing new theories of causation, based on the intricate interplay of environmental toxins, nutrition and gene expression.<sup>31</sup> Epigenetics is key to this new understanding. Genes carry the information that tells the body what to do and when to do it; the reading of this information is called “gene expression.” Epigenetics describes how the proteins forming the environment around genes—the epigenome—changes how they are expressed. We now know environmental toxins, like mercury and pesticides, along with nutritional deficiencies, can change the epigenome and alter the regulation of how genes are expressed, with adverse impacts on the development of the brain and nervous system. Most surprising to people is the realization that these environmental changes—epigenetic changes—can be

inherited without any change in the underlying DNA. Epigenetic dysregulation<sup>32</sup> is associated with the development of autism; examples include:

- “Turned on” or activated genes produce proteins or enzymes that help the body protect itself against oxidative stress, a core process by which our environment can harm us. Exposing the body to inorganic mercury, for example, can alter normal sulfur metabolism, impairing methylation, which is necessary for the body to excrete some toxins. Some individuals with autism have genetic polymorphisms that impair sulfur metabolism, methylation and this process of detoxification.<sup>33</sup>
- Foodborne and chemical “excitotoxins” elevate glutamate levels and can cause degeneration of nerve cells.<sup>34</sup>
- Environmental toxins impact the function of particular nervous system cells, called microglia, altering gene expression in individuals with Rett Syndrome, a disorder on the autism spectrum.<sup>35</sup>

As we learn more about autism, it appears that the etiology of autism has much in common with that of cancer in that there is never one cause, but rather is the result of multiple assaults on the immune system.

## Endnotes

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