Do Environmental Toxins Contribute to ADHD Symptoms?

by L. Eugene Arnold, MD, MEd

TWO RECENT PEER-REVIEWED ARTICLES in respected medical journals have shed new light on a possible link between modern chemicals and ADHD. One, in *Pediatrics*, reported on organophosphate insecticide residues and metabolites in children's urine. The other, in the *American Journal of Epidemiology*, reported on chemicals leaking from materials used in construction, industry, and consumer products (such as polychlorinated biphenols, or PCB) in the cord blood of babies born to mothers living near a contaminated harbor. These two articles were considered important enough to merit an editorial in the prestigious *Journal of the American Medical Association*.

The results are similar to two other reports released in the summer of 2010 by the National Institute of Environmental Health Sciences, one for insecticide residues in mothers' serum during pregnancy, the other for polyfluoroalkyl chemicals (PFCs) in children's serum.

What have we learned?

In all four studies, the children's symptoms or diagnosis of ADHD correlated significantly with the amount of chemical residue or metabolite in their urine, serum, cord blood, or in their mother's serum during pregnancy.

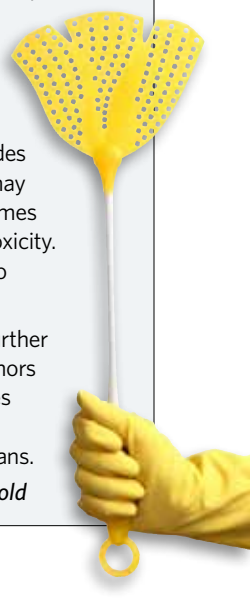
For example, a diagnosis of ADHD

What should we do?
Some common-sense precautions

- Don't panic. This new knowledge does not change the real risk (or lack of risk) that already exists. It just provides a beginning of finding ways to improve future safety.
- Remember that with any environmental toxin, it is the amount that counts. Tiny amounts do not pose a risk unless they accumulate over time to a large amount.
- Any reasonable precaution that reduces total exposure will help keep the cumulative dose safe.
- Use common sense in avoiding known or suspected places of contamination.

- Wash fruits and vegetables thoroughly, using soap or another cleansing method where practical. A vegetable scrubber may help with hard-skinned fruits and vegetables such as apples or squash. This obviously includes produce where one eats the skin, but also applies to melons, potatoes, and other produce that is routinely cut or peeled, so that the knife does not carry contaminants from the skin into the edible part.
- If organic produce is too expensive for your budget, the most important organic items to purchase would be those that cannot be scrubbed, such as leafy vegetables or berries. These should be gently washed.
- If your backyard gets some sun, you can raise berries and some vegetables without insecticides. Although this only works in season, it reduces the total annual exposure.
- Ask your local water company what tests are done for contaminants and obtain the results. If in doubt about your supply, you can purchase a filter for the drinking water faucet. It is usually not necessary to buy expensive bottled water.
- Air out your car upon first entering it after it sits closed up for awhile.
- Paint, install new carpet, or remodel when the weather is warm enough to leave windows open during the activity and a day or two afterward. Insure adequate ventilation where you are constructing or renovating, and clean up all dust and trash thoroughly.
- Be sparing in use of artificial materials in cooking, such as nonstick surfaces and plastic receptacles, especially where heat is involved.
- Be especially sparing in use of household insecticides and other chemicals. In many cases a sticky trap may substitute for a spray chemical. Boron may sometimes manage a roach problem without known human toxicity. Fly swatters and electrocuting bug zappers have no known toxicity.
- Remember that cause has not been established; further study is required. This point was also made by authors of the articles. Our current state of knowledge gives people inclined to political action a better basis to advocate for more research than to advocate for bans.

— L. Eugene Arnold



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was more likely in children with higher urine insecticide metabolites. A tenfold increase in dimethyl alkylphosphate (a metabolite of malathion, a common insecticide sold over the counter) significantly raised the odds of having ADHD. Children with urinary levels of dimethyl thiophosphate above the average of detectable amounts had twice the odds of having ADHD compared to those with no detectable level. The authors thought that the most likely source of the insecticide residue was fruits and vegetables, especially unwashed produce. They point out that up to a fourth of frozen fruits and vegetables have been reported to have insecticide residue.

Similarly, the study of cord blood found that children in the top twenty-five percent of PCB levels had 1.76 times the risk of ADHD symptoms compared to those in the bottom twenty-five percent of PCB levels. The study of the mothers' serum found that prenatal dialkyl phosphate insecticide residues were highly associated with ADHD symptoms in their children at age five, although not at age three-and-a-half, suggesting a delayed effect (or possibly better measurement tools at age five). The study of PFCs found a significant correlation between child serum levels at age twelve to fifteen and ADHD diagnosis.

Thus, four different recently published studies show a link between ADHD diagnosis or ADHD symptoms and insecticide or other chemical residues or metabolites in children's blood or urine or their mother's gestational blood. None of these manmade chemicals were used a century ago. Therefore the question arises as to whether these chemicals might explain part of the increase in ADHD diagnoses over the past forty years. The widely documented genetic risk could be a genetic vulnerability to such chemicals. Before jumping to such conclusions, however, some limitations of the studies must be considered.

A nationally recognized child psychiatrist with more than forty years of academic and clinical experience, **L. Eugene Arnold, MD, MEd**, *is professor emeritus of psychiatry at Ohio State University. Arnold has been involved in numerous studies involving ADHD and is the author of nine books and more than a hundred articles in professional journals. He is also a researcher on the National Institute of Mental Health's Multimodal Treatment Study.*

Limitations of the studies

Most importantly, these studies by themselves do not support a conclusion that these chemicals cause ADHD. The statistical links reported could have resulted from things other than a direct cause. For example, children with ADHD may get into things that expose them more to the chemicals, or families with a lot of ADHD may neglect washing fruit and

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vegetables before eating them (reverse causality). Mothers exposed to such chemicals while pregnant may also have other health hazards that are the real cause. Environments contaminated with these chemicals may also be contaminated in other ways, such as with heavy metals or microbes, even parasites. Establishing causality will require further study with different designs.

Another problem is that the ADHD diagnosis was not established in a rigorous research fashion. Some of the studies just measured symptoms from a checklist or asked parents if a diagnosis had been made. There was little or no effort to rule out other explanations of the symptoms. Some checklists that were used for identifying ADHD were not up-to-date with respect to current diagnostic criteria. Therefore we cannot be sure that it was really ADHD with which the contaminant levels correlated.

We also cannot be sure it was actually the chemicals themselves that were absorbed by the people tested. In some cases the tests were done on breakdown products of the original chemicals. As one of the authors noted, it is possible that people only absorbed the breakdown products, not the original toxins.

Finally, at least one of the studies was done in an unusual environment, the contaminated harbor. The toxin levels in that environment may have produced results not applicable to most of the country. "The dose alone makes the poison," said Paracelsus, the Renaissance physician considered the father of toxicology. The lower levels found elsewhere may not show the same correlations with ADHD. On the other hand, two of the studies used National Health and Nutrition Study data, which should be representative of the whole country.

Nevertheless, the studies were well done and the results believable, as far as they went. They certainly establish a compelling case for further study. They also suggest some common-sense precautions to take in the meantime, just to be safe.

FOR MORE INFO Visit ***Attention 2.0*** at chadd.org for summaries and links to these studies or articles.

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