

## CEHN Article of the Month, October 2016 Issue

### Title

Polychlorinated Biphenyl and Organochlorine Pesticide Concentrations in Maternal Mid-Pregnancy Serum Samples: Association with Autism Spectrum Disorder and Intellectual Disability

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### Abstract

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#### *Background*

According to the Centers for Disease Control and Prevention (CDC), 1 in 68 children in the United States (U.S.) are identified with autism spectrum disorder (ASD), with boys being 4.5 times more likely than girls to be diagnosed<sup>1</sup>. More than 545,000 children (ages 6 - 21) in the U.S. are diagnosed with intellectual disability (ID)<sup>2</sup>. A combination of genetic and environmental factors can influence a child's brain and central nervous system development (neurodevelopment), including the likelihood to develop ASD and ID. There is increasing evidence that certain toxic chemicals play a crucial role in negatively affecting neurodevelopment and may contribute to the development of ASD and ID.

Organochlorine compounds (OCC) are one such class of neuro- toxicants. Polychlorinated biphenyl ethers (PCBs) and organochlorine pesticides (OCPs) are two types of OCCs. These chemicals were widely used in the U.S. during the 1940s through the 1960s as pesticides. While banned in the 1970s by the U.S. Environmental Protection Agency (EPA) due to health concerns, they persist in the environment and food chain for a very long time.

Thus, children and adults today are still exposed to pre-existing amounts of OCCs through contaminated food, contaminated water, and industrial accidents. Contaminated food (primarily fish, meat, and poultry - foods high in fat) is the main source of exposure. Exposure through contaminated water and industrial accidents is very small and rare<sup>3</sup>. Pregnant women are at risk of passing PCBs and OCPs to their unborn children, because these chemicals have the ability to cross the placenta during pregnancy. Previous studies have suggested a link between ASD and postnatal exposures to these chemicals, however few studies have specifically examined prenatal exposure of these toxicants with risk of ASD and ID.

#### *Objective*

The objective of this study was to determine if the prenatal exposure of PCBs and OCPs increased offspring's risk of Autism Spectrum Disorder or Intellectual Disability without autism.

#### *Methods*

The study population consisted of mother-infant pairs from 3 counties in Southern California. Mother-infant pairs who had maternal blood samples collected during the 2nd trimester of pregnancy and newborn blood samples available were included in the study. The blood samples were tested for different types of PCBs and OCPs.

Among the mother-infant pairs, 3 study groups were created using information provided by the Department of Developmental Services: children with autism spectrum disorder (ASD), children with an intellectual disability but not autism (ID), and general population (GP).

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<sup>1</sup>Autism Spectrum Disorder: Data & Statistics. Retrieved September 13, 2016 from <http://www.cdc.gov/ncbddd/autism/data.html>

<sup>2</sup>Children with Intellectual Disabilities. Retrieved September 27, 2016 from <https://www.healthychildren.org/English/health-issues/conditions/developmental-disabilities/Pages/Intellectual-Disability.aspx>

<sup>3</sup>PCBs Polychlorinated biphenyls. Retrieved September 14, 2016 from <http://www.greenfacts.org/en/pcbs/index.htm#1>

Mother-infant pairs with ASD and mother-infant pairs with ID were matched with mother-infant pairs in the GP group based on infant sex, birth year, and birth month. The matches were assessed to determine if there was an association between exposure to PCBs and OCPs, and risk of ASD or ID.

### Results

The study results indicated that higher levels of some types of PCBs, but not OCPs, were associated with higher risk of ASD. Researchers identified two types of PCB in particular, PCB 138/158 and PCB 153, as having a significant impact on a child's risk of developing ASD. PCB 138/158 was also significantly associated with increased risk of ID, though no trend was seen. ID was also associated with p,p'-DDE exposure, but the relationship was not linear.

The study findings also indicated the possible influence of sex, race/ethnicity, and socioeconomic status on both exposure and neurodevelopmental outcome. For example, results supported previous research findings that boys were four times more likely to have ASD than girls. Also, a higher proportion of Hispanic children and children of mothers who used government insurance plans at delivery were diagnosed with ID compared to other groups. Mother-infant pairs with higher socioeconomic status were more likely to have higher levels of PCB in their blood, whereas pairs with lower socioeconomic status were more likely to have higher levels of OCPs.

### Conclusion

Similar to results from previous studies, these findings suggest an increased risk of ASD and ID with prenatal exposure to higher levels of OCCs. However, this study provides stronger evidence for this association, because the study used a larger sample size and only analyzed blood samples that had higher levels of OCC exposure.

### Policy Implications

EPA banned organochlorine chemicals in the 1970s. Thus, today, laws only permit PCBs to be produced in "totally enclosed products" which are defined as products where there is no exposure to humans, and DDT, like other OCPs, is not permitted to be sold or used in the U.S. unless there is an EPA-declared state of emergency<sup>4,5</sup>.

Because EPA has already placed bans on these chemicals, it is a matter of addressing pre-existing amounts of OCCs produced prior to the ban. State Environmental Protection Agencies such as Illinois EPA have produced resources to educate their citizens on how to limit their intake of PCBs from food. One such resource from Illinois EPA is the Guide to Eating Illinois Sporting Fish, which recommends what fish one should and should not eat, and proper ways to cook the fish in order to reduce one's intake of PCBs<sup>6</sup>. However, more can be done to raise awareness of the dangers of OCCs, create resources that recommend ways to limit one's intake, and to promote the availability of these resources. More funding at federal, state, and local levels for effective public health campaigns is needed in order to raise public awareness and educate on risk reduction.

Another PCB exposure pathway is through old fluorescent light ballasts (FLBs), which were approved by the EPA in the 1970s as a totally enclosed product. However, all PCB-containing fluorescent light ballasts currently in use have exceeded their designated life span and are vulnerable to leaking or rupturing. Many are still in school buildings, and this poses a threat to not only children but also female employees who are of child-bearing age<sup>7</sup>. Currently, the EPA is

<sup>4</sup>Electronic Code of Federal Regulations. Retrieved September 13, 2016 from <http://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=9cc5c7c61a85dafcf349cfe90be7eae7&mc=true&n=pt40.34.761&r=PART&ty=HTML>

<sup>5</sup>DDT (General Fact Sheet). Retrieved September 14, 2016 from <http://npic.orst.edu/factsheets/ddtgen.pdf>

<sup>6</sup>Illinois Department of Public Health - PCBs. Retrieved September 14, 2016 from <http://www.idph.state.il.us/cancer/factsheets/polychlorinatedbiphenyls.htm>

<sup>7</sup>Polychlorinated Biphenyl (PCB) - Containing Fluorescent Light Ballasts (FLBs) in School Buildings. Retrieved September 21, 2016 from <https://www.epa.gov/pcbs/polychlorinated-biphenyl-pcb-containing-fluorescent-light-ballasts-flbs-school-buildings>

reassessing ongoing authorized uses of PCBs in order to update their rules enacted in 1998. The EPA has projected a notice of proposed rulemaking for October of this year<sup>8</sup>.

This study is one of the few studies that has researched prenatal exposure to OCCs. The findings suggest a link between in utero PCB exposure and risk of ASD in offspring, and support already existing research linking PCBs and OCPs to disruption of neurodevelopment. However, more research is needed to further investigate the effect of OCC's in association with ASD and ID, particularly during pregnancy.

## Reference

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Article available in [Environmental Health Perspectives](#)

## Keyword(s)

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[Organochlorine Compounds](#), [Neurotoxicants](#), [Intellectual Disability \(ID\)](#), [Autism Spectrum Disorder \(ASD\)](#)

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<sup>8</sup>Polychlorinated Biphenyls (PCBs); Reassessment of Use Authorizations for PCBs in Small Capacitors. Retrieved September 21, 2016 from <https://yosemite.epa.gov/opei/RuleGate.nsf/byRIN/2070-AK12#2>