

## December Article of the Month

### Environmental Chemicals in an Urban Population of Pregnant Women and their Newborns in San Francisco

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#### **Background:**

Numerous studies have linked prenatal exposure to environmental chemicals and heavy metals with the development of adverse health effects including neurodevelopmental disorders, cancer, preterm birth, and birth defects.

Some of these environmental chemicals include compounds classified as persistent organic pollutants (POPs). There are a number of different classes of POPs including polychlorinated biphenyls (PCBs), which were used in transformers and electrical equipment due to their non-flammability and stability; organochlorine pesticides (OCPs), which were used in agriculture and mosquito control; perfluorinated compounds (PFCs), which are used in cookware, furniture, carpets, clothing, and mattresses to make them resistant to grease and oil; and polybrominated diphenyl ethers (PBDEs), which are used as a flame retardant in a number of commercial and household products.

POPs break down very slowly, causing them to persist in the environment for years (even after they have been banned from production or use), and increasing the potential for human exposures. They also tend to accumulate in the fatty tissues of animals, increasing in concentration (bioaccumulating) as they move up the food chain. Therefore, humans are primarily exposed to POPs through eating contaminated meats and fish, and sometimes dairy products, especially those high in fat. Another source of human exposure is through ingestion or inhalation of contaminated house dust.<sup>1</sup>

Heavy metals such as cadmium, lead, and mercury are toxic to the brain and nervous system, and have been linked with increased risk of intellectual disability, low birthweight and preterm birth. Humans are primarily exposed to cadmium through smoking and

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<sup>1</sup> PCBs Polychlorinated biphenyls. Retrieved November 21, 2016 from <http://www.greenfacts.org/en/pcbs/index.htm#1>.  
Organochlorine Pesticides. Retrieved November 29, 2016 from <http://dhss.delaware.gov/dhss/dph/files/organochlorpestaqa.pdf>.  
Perfluorinated Chemicals. November 21, 2016 from [https://www.niehs.nih.gov/health/materials/perfluorinated\\_chemicals\\_508.pdf](https://www.niehs.nih.gov/health/materials/perfluorinated_chemicals_508.pdf).  
Technical Fact Sheet: PBDEs. Retrieved November 29, 2016 from [https://www.epa.gov/sites/production/files/2014-03/documents/ffrrofactsheet\\_contaminant\\_perchlorate\\_january2014\\_final\\_0.pdf](https://www.epa.gov/sites/production/files/2014-03/documents/ffrrofactsheet_contaminant_perchlorate_january2014_final_0.pdf).  
PBDEs: New Pollutants – Old Diseases. Retrieved November 29, 2016 from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1069057/>.

through inhalation via the burning of fossil fuels and municipal waste.<sup>2</sup> Exposure to lead is primarily a result of ingesting paint chips or paint dust from homes, buildings, or structures older than 1978 with poorly maintained paint. Drinking water contaminated with lead can be another source of human exposure, particularly in areas serviced by old lead water supply service lines, in areas with poor water treatment for corrosion control, or in homes or buildings with internal plumbing fixtures containing lead.<sup>3</sup> Human exposure to mercury is primarily through the consumption of fish and shellfish contaminated with methylmercury due to industrial and power plant emissions.<sup>4</sup>

Previous studies have found that these environmental chemicals and heavy metals can be detected in greater than 99% of pregnant women in the U.S. Moreover, these exposures have the potential to pass from the mother, through the placenta, to the fetus, and these prenatal exposures can result in adverse lasting health effects to the developing child. Few studies have specifically characterized the transfer of these particular chemicals from the mother to the unborn child.

### **Objective:**

The objective of this study was to better characterize prenatal exposures to multiple environmental chemicals and heavy metals among primarily urban, Latina women and assess the transfer of these chemicals between mother and fetus.

### **Methods:**

The study population consisted of primarily Latina women who were in their second or third trimester and receiving treatment from the San Francisco General Hospital (SFGH) Women's Health Center between October 2010 and June 2011. Two thirds of the women were foreign born, 95% had a household income of less than \$40,000, and all were participating in the Chemicals in Our Body Study (CIOB).

There were 65 maternal (mother and fetus) pairs in the study. Maternal blood samples during labor and delivery, and blood samples from the umbilical cord after delivery were collected for each pair. Each blood sample was analyzed for 59 different chemicals which included PCBs, OCPs, PBDEs, PFCs, and metals (cadmium, lead, and mercury).

### **Results:**

The results found many chemicals in maternal blood samples and in umbilical cord blood samples. On average, 25 chemicals were found in each maternal blood sample, and 17 chemicals were found in each umbilical cord blood sample. Eight chemicals, including lead and mercury, appeared in over 90% of blood samples. The results indicated high fetal

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<sup>2</sup> Cadmium Compounds. Retrieved November 21, 2016 from <https://www.epa.gov/sites/production/files/2016-09/documents/cadmium-compounds.pdf>.

<sup>3</sup> Lead Compounds. Retrieved November 21, 2016 from <https://www.epa.gov/sites/production/files/2016-09/documents/lead-compounds.pdf>

<sup>4</sup> Toxic Substance Portal. Retrieved November 21, 2016 from <http://www.atsdr.cdc.gov/toxfaqs/TF.asp?id=113&tid=24>

transfer (transfer of chemicals from the mother to the fetus) for many of the chemicals. For chemicals detected in at least 20 paired maternal samples, there was a moderate-to-strong correlation between maternal and umbilical cord concentrations.

### **Conclusion:**

This study measured nearly 60 environmental chemicals in matched maternal and umbilical cord blood samples in the U.S. Results found this primarily Latina and largely low-income population to be exposed to numerous chemicals. Many of the chemicals detected in maternal blood samples were also detected in umbilical cord blood samples, indicating that they passed through the placenta and entered the fetal environment. There was a moderate-to-strong correlation between maternal and umbilical cord concentrations for the majority of chemicals detected in at least 20 paired maternal samples.

### **Policy Implications:**

There has been a gradual decrease in the levels of bioaccumulative compounds in the U.S. due to voluntary phase out and regulatory bans. In 2001, the Stockholm Convention on Persistent Organic Pollutants called for the immediate ban of production and use of 12 key POPs, which the U.S. signed. Regulations passed by the U.S. Environmental Protection Agency (EPA) have played a considerable role in moving the U.S. toward the goal of eliminating and restricting the use of all intentionally produced POPs.<sup>5</sup>

In the 1970s, the EPA banned PCBs and OCPs, allowing them to be produced only in “totally enclosed products”. Currently the EPA has projected a notice of proposed rule-making in March of 2017 to update regulations regarding pre-existing amounts of PCBs in “totally enclosed products” such as old fluorescent light ballasts, which can be found in many schools throughout the country.<sup>6</sup> The EPA has been working to reduce the production of certain types of PBDEs as well, while some states have banned certain types of PBDEs altogether.<sup>7</sup> With regard to PFCs, the EPA continues to phase out these compounds to reduce their environmental and health impacts.<sup>8</sup> Some initiatives include adding PFCs to the Contaminant Candidate List under the Safe Drinking Water Act, and posing the possibility of requiring the phase out of PFCs in industrial plants under the Clean Air Act.<sup>9</sup>

Two other toxicants of high concern are mercury and lead. To help reduce mercury emissions from power plants, the EPA finalized the Mercury and Air Toxics Standards (MATS) in 2016. The standards set through MATS is predicted to save the U.S. between \$37

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<sup>5</sup> Persistent Organic Pollutants: A Global Issue, A Global Response. Retrieved November 23, 2016 from <https://www.epa.gov/international-cooperation/persistent-organic-pollutants-global-issue-global-response>.

<sup>6</sup> Polychlorinated Biphenyls (PCBs); Reassessment of Use Authorizations for PCBs in Small Capacitors. Retrieved November 21, 2016 from <https://yosemite.epa.gov/oepi/RuleGate.nsf/byRIN/2070-AK12#2>

<sup>7</sup> Polybrominated Diphenyl Ethers. Retrieved November 21, 2016. <https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/polybrominated-diphenyl-ethers-pbdes#current>

<sup>8</sup> Perfluorinated Chemicals. Retrieved November 21, 2016 from [https://www.niehs.nih.gov/health/materials/perfluorinated\\_chemicals\\_508.pdf](https://www.niehs.nih.gov/health/materials/perfluorinated_chemicals_508.pdf)

<sup>9</sup> Per- and Polyfluoroalkyl Substances (PFASs): What EPA is Doing. Retrieved November 21, 2016 from <https://www.epa.gov/pfas/and-polyfluoroalkyl-substances-pfass-what-epa-doing#tab-1>.

and \$90 billion in health care costs per year.<sup>10</sup> As a means to minimize human exposure to lead paint dust, the U.S. Department of Housing and Urban Development (HUD) has developed requirements for all federally-assisted housing older than 1978. This includes requiring federally-assisted housing to have lead based paint inspections and maintenance by a certified abatement contractor.<sup>11</sup> In 2010, the EPA required that homes, child care facilities, and kindergartens built before 1978 that have plans to renovate, repair, or repaint the property must use an EPA or state certified renovator in order to prevent lead contamination and limit exposure to lead paint chips and dust.<sup>12</sup>

EPA regulates lead in drinking water via the Lead and Copper Rule under the Safe Drinking Water Act. The drinking water infrastructure (e.g., supply pipes, service lines, etc.) in many parts of the U.S. is old and in some areas contain lead, and without proper corrosion control techniques, lead can leech into the water.<sup>13</sup> It is imperative that best practices are implemented with regard to delivering drinking water to residents.

Federal emissions, manufacturing, and maintenance regulations enacted over the past decade have resulted in decreased concentrations of certain toxicants in the environment, in consumer products, and in people. However, investment in our public housing, schools, and drinking water infrastructure is needed to further reduce and prevent unnecessary exposures to children. The EPA should remain vigilant about testing the safety to children of those persistent organic compounds that are still in use, and about reviewing, updating, and tightening standards, phase-outs, or other limitations on certain compounds or metals according to their relevant legally-mandated schedules. Consideration of multiple exposures, especially among populations that experience cumulative risk factors, is important. In addition, community-level services (such as childhood lead prevention programs) need strong support for screenings, surveillance, and prevention activities. While rules have been promulgated and standards set, it is imperative that implementation of the rules, and enforcement capabilities are adequately funded in order to best protect children's health.

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<sup>10</sup> Healthier Americans. Retrieved November 21, 2016 from <https://www.epa.gov/mats/healthier-americans>.

<sup>11</sup> Lead-safe Housing Rule Requirements. Retrieved November 23, 2016 from [http://portal.hud.gov/hudportal/HUD?src=/program\\_offices/healthy\\_homes/enforcement/lshr\\_summary](http://portal.hud.gov/hudportal/HUD?src=/program_offices/healthy_homes/enforcement/lshr_summary).

<sup>12</sup> Lead Renovation, Repair, and Painting Program Rules. Retrieved November 23, 2016 from <https://www.epa.gov/lead/lead-renovation-repair-and-painting-program-rules>.

<sup>13</sup> Lead Regulations. Retrieved November 21, 2016 from <https://www.epa.gov/lead/lead-regulations>.