PRE-POLLUTED

environmental defence

A report on toxic substances in the umbilical cord blood of Canadian newborns

June 2013

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By ENVIRONMENTAL DEFENCE

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Any errors or omissions in this report are the sole responsibility of ENVIRONMENTAL DEFENCE.

About ENVIRONMENTAL DEFENCE

ENVIRONMENTAL DEFENCE is Canada's most effective environmental action organization. We challenge, and inspire change in government, business and people to ensure a greener, healthier and prosperous life for all.

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ENVIRONMENTAL DEFENCE
116 Spadina Avenue, Suite 300
Toronto, Ontario M5V 2K6

Visit **environmentaldefence.ca** for more information.

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EXECUTIVE SUMMARY

Canadian children are being born pre-polluted.

ENVIRONMENTAL DEFENCE tested the umbilical cord blood of three newborn babies and found each child was born with 55 to 121 toxic compounds and possible cancer-causing chemicals in their bodies. Of the 137 chemicals found in total, 132 are reported to cause cancer in humans or animals, 110 are considered toxic to the brain and nervous system and 133 cause developmental and reproductive problems in mammals.

If evidence that babies—some of the most vulnerable individuals in our society—are burdened with a toxic chemical load before they are born is not enough to signal a change must be made, we don't know what is.

These test results, taken from three newborns whose mothers live in the Greater Toronto and Hamilton Areas, are a dramatic example of the burden of chemicals that Canadians may bear without knowing it. The chemicals in the umbilical cord blood samples were detected at low levels. Still, this is a cause for concern because toxicity assessments are usually based on adult exposures, and little is known about how low level exposures to heavy metals, endocrine-disruptors and carcinogens affect the fetus or newborn specifically. Furthermore, additive, cumulative, and synergistic effects of many common pollutants have not been adequately investigated by scientists.

Though the sample size is small, the results are consistent with larger cord blood studies in other jurisdictions and are yet another illustration of why action to eliminate our exposure to hazardous chemicals is so critically important. The women who volunteered to have their newborn babies' cord blood tested do not work in an industrial setting, where these chemicals might be handled as part of routine operations.

These women are not alone. On a daily basis, Canadians coast-to-coast are exposed to chemicals at home, in workplaces and in the greater environment, which have links to cancer, hormone-disruption, and other serious health problems. The urgency of the need to reduce exposure to carcinogens in the environment is underlined by the *U.S. President's Cancer Panel in Reducing Environmental Cancer Risk: What We Can Do Now (2010)*. Based on input from 45 experts in oncology and cancer prevention, the panel concluded that environmental causes of cancer are "grossly underestimated."[1]

If evidence that babies—some of the most vulnerable individuals in our society—are burdened with a toxic chemical load before they are born is not enough to signal a change must be made, we don't know what is.

Cancers in hormone-sensitive tissues in humans (such as the breast, testes, thyroid, prostate and ovaries) are on the rise—sharply. Between 1973 and 1998, the rate of testicular cancer in U.S. males skyrocketed by 44 per cent.[2] Breast cancer rates are increasing in most industrialized countries, and the rise cannot be fully explained by improvements in mammography or changes in risk factors such as inheritance, or age at time of childbearing.[3] Thyroid cancer rates have been increasing more rapidly than any other solid tumour and according to Cancer Care Ontario, "The incidence of thyroid cancer in 15–29 year-old women in Ontario increased rapidly at an average rate of five per cent per year between 1981 and 2009."[4]

In light of these and other findings, the UN and WHO issued a report in February 2013 calling attention to recent spikes in rates of hormone-related cancers, and raising concerns about possible links to increased exposures to endocrine-disrupting chemicals (chemicals that mimic the effects of hormones) in consumer products.

Governments aren't keeping up to make sure citizens are protected from these chemicals. Currently more than 84,000 chemicals are in use in North America; examinations of the European Union's REACH registry estimate the number of chemicals in commerce globally may be closer to 143,000.[5] To date, Canada's Chemicals Management Plan (CMP) has only reviewed 200 chemicals for their impact on human health and the environment, with plans to review an additional 300 by 2016.[6] The U.S. Environmental Protection Agency (EPA) has only reviewed 200 chemicals since the *Toxic Substances Control Act* was passed in 1976.[7]

While some progress has been made in the regulation of toxic substances, there remain thousands of chemicals—which are possibly putting our health at risk—in our homes and workplaces that haven't been reviewed or have received screening level review with very limited data available to decision makers.

Our test results demonstrate the urgency of the problem: the overabundance of harmful chemicals in our environment. We tested the umbilical cord blood samples for a total of 310 chemicals and found 137. The chemicals we tested for represent common toxic pollutants in North America, all of which are reported to have human health impacts ranging from lowered IQ, to thyroid problems and cancer.

The developing fetus is especially at risk from these effects as it grows rapidly and lacks systems to process waste and flush out toxins. Newborns do not have the physiological defences that adults have, and studies have shown that the endocrine system (which regulates the body's hormones) is more sensitive to the effects of toxic exposures during certain windows of vulnerability in human development—especially gestation, infancy and puberty.[8]

The chemicals we tested for fall into seven groups:

1 **DIOXINS AND FURANS: two chemicals found across the three cord blood samples.**

By-products of any combustion process, including waste incineration and manufacturing processes such as pulp and paper bleaching, the main source of exposure to these chemicals is through food. They are toxic to the immune system, nervous system, reproductive system, endocrine system, and are linked to cancer.

2 **PBDEs (polybrominated diphenyl ethers): 22 chemicals found across the three cord blood samples.**

These chemicals are used to slow the spread of fire in upholstered furniture, mattresses, electronics and other products, but doubts have been raised regarding their effectiveness. PBDEs are being phased out in Canada, but they build up in fatty tissue, and are highly persistent. Health effects include neurodevelopmental disorders, thyroid damage, and suspected links to cancer.

3 **PFCs (perfluorocarbons): two chemicals found in one cord blood sample.**

Some PFCs have been phased out of industrial production, but others remain on the market in products with non-stick coatings, food packaging, and fabrics with water resistant treatments. PFCs are persistent and have been identified as endocrine-disruptors.

4 **ORGANOCHLORINE PESTICIDES (OCs): 10 chemicals found across the three cord blood samples.**

The most infamous of these is DDT. 4,4'-DDT was detectable in one of the cord blood samples, despite the fact that it has been banned in Canada since 1970. Before they were banned, OC pesticides were mainly used in agricultural crops. The OC pesticides detected are legacy chemicals, meaning they persist in the environment, and are reported to be toxic to the nervous system. Chronic exposure affects fertility.

5 **METHYLMERCURY: Found in all three newborns.**

Mercury is a naturally-occurring, highly toxic, substance that comes in more than one form. When inorganic mercury enters the environment from combustion (e.g. coal burning power plants), mining and manufacturing and urban sources such as compact fluorescent light bulbs, thermometers and electrical switches, some of it transforms into methylmercury. It is neurotoxic, is a suspected endocrine-disruptor, and is toxic to the reproductive system.

6 **LEAD: Found in all three newborns.**

Lead is a naturally occurring heavy metal but exposure can occur through emissions from metal smelters, old leaded gasoline, paint, and tire weights, and through impurities in products such as lipstick. It is neurotoxic, an endocrine-disruptor, a suspected carcinogen, and no safe level of exposure is known.

7 **PCBs (polychlorinated biphenyls): 96 chemicals found across the three cord blood samples.**

Banned from production and importation in Canada since 1977, PCBs are highly persistent and build up in fatty tissue. They also cross international boundaries. They are classified as carcinogenic, and toxic to the immune, reproductive and neurological systems.

Our test results demonstrate the urgency of the problem: the abundance of harmful chemicals in our environment.

These test results highlight how long toxic chemicals can stay in our environment and bodies. PCBs, DDT (an organochlorine pesticide banned in Canada in 1970 and banned in the U.S. in 1972) and the PFC known as PFOS, have already been banned. Yet, they are still turning up in umbilical cord blood, having been passed from mother to baby.

Canadians should have the right to live in a clean, healthy environment, but our tests indicate that before birth, our bodies are already contaminated by hazardous chemicals, some of which have been banned for decades.

Previous studies have looked at selected contaminants, but the developing fetus is exposed to a broad range of contaminants. The problem is alarming enough that Health Canada has collected umbilical cord blood for analysis through a program called MIREC. Though the study has been ongoing for some time, the results have yet to be released.

ENVIRONMENTAL DEFENCE has been conducting tests to investigate the toxic body burden of Canadians since 2005. Our studies on children and adults have influenced government to investigate further, and to improve regulations and monitoring of chemicals in the marketplace and in the environment. The sample size for the present study was small, but the results are consistent with studies that have been conducted in other jurisdictions, namely the U.S. It is our hope that by publishing these results, we will see the problem further investigated by government and academics.

With this report, ENVIRONMENTAL DEFENCE hopes to raise awareness of the need for urgent action in banning hazardous substances, to protect the health of all Canadians, the environment and future generations.

Babies are more susceptible to the harmful effects of toxic chemicals. This is because they absorb more into their bodies, pound for pound, than adults do.

RECOMMENDATIONS

1 The federal government should move to ban harmful chemicals from consumer products, such as furniture and clothing. For chemicals for which phase outs have been announced, the government should establish clear, strict timelines for removing these chemicals from the marketplace, and and conduct research into and promote safe substitutions for toxic substances.

2 The federal government should test chemicals used in consumer products for toxic effects before they can be sold to Canadians. This is consistent with the precautionary approach the EU is taking to protect its citizens.

3 In light of the startling findings in all three cord blood samples tested, further large scale testing of the toxic body burden of newborns in Canada is needed to scientifically assess the scale of the issue. Our understanding is that Health Canada has resources assigned to this task, so we urge the quick release of its results.

4 Industry should continue to act proactively to remove toxic chemicals from products ahead of government plans to phase them out. Brominated flame retardants (PBDEs) and perfluorinated chemicals (PFCs) should be removed from the marketplace in order to protect the health of consumers. In addition, industry should conduct transparent alternatives assessments, and practice safe substitutions, replacing toxic chemicals with substances that have been adequately tested.

INTRODUCTION

Toxic Exposures Before Birth

Until recently, it was generally believed that the placenta protected the developing fetus from exposure to potentially harmful chemicals in the mother's environment. Even as awareness of toxics such as DDT, mercury, and lead was rising in Canada and the U.S. in the 1970s, and the public grew concerned about the health of people and wildlife, it was not understood that humans are exposed to and affected by exposure to toxic chemicals even before we are born.

Newborn children need adults to protect and nurture them for their survival. Babies are more susceptible to the harmful effects of toxic chemicals. This is because they absorb more into their bodies, pound for pound, than adults do. It's also because their bodies are less able to get rid of toxic chemicals the way adult bodies can. This means that chemicals that cause problems for adult hormone or nervous systems are of even greater concern in children and babies.

In utero exposure to flame retardant chemicals, such as PBDEs, is associated with lower IQ and hyperactivity.[9] The UNEP and WHO report *State of the Science of Endocrine-Disrupting Chemicals 2012* states that the breast is particularly vulnerable to exposure to cancer-causing chemicals during development in the womb.[10] This means female children are born with a potentially higher risk of developing breast cancer later in life as a result of chemical exposures that took place during the mother's pregnancy, and persistent chemicals in the mother's system that she may have absorbed long before conception.

When it comes to protecting the most vulnerable among us from exposure to carcinogenic, endocrine-disrupting and hazardous chemicals, the responsibility falls not on the shoulders of mothers, but on society as a whole. Citizens, government, and industry all have a role to play in reducing toxic pollution.

Canadians can take steps to limit their exposure to some toxic chemicals, but products are not always clearly labeled. In addition, in cases where a ban or phase out has been announced, Canadians might expect that the chemical is no longer in products, but the lag time between announcing a phase out, and the actual removal of a toxic substance from products, may take many years.

Some progress has been made by Health Canada and Environment Canada to review and ban hazardous chemicals under the *Chemicals Management Plan (CMP),* and to phase out persistent organic pollutants under the Stockholm Convention (an international environmental treaty aimed at reducing pollution). However, a significant delay often occurs between the announcement of a planned ban, or a declaration that a substance is toxic, but products are not often clearly labelled.

For example, Canada first proposed to eliminate the synthetic chemical perfluorooctane sulfonate (PFOS)—used as an additive and stain repellent and linked to development and reproductive problems—in October 2004. In July 2006, the Canadian government published their final assessment of the chemical, but it wasn't until June 2008 that the final regulations, enacting the ban, were published.

A similar story can be told of the flame retardants PBDEs. In 2006, the federal government first proposed a risk management strategy to reduce PBDEs to the lowest possible level.[11] *The Final Revised Risk Management Strategy* was published in 2010, and included prohibitions on importing the chemicals. But prohibitions on importing products containing PBDEs are needed as well. Dust from items such as furniture and mattresses are key sources of household exposure to PBDEs.[12] As of this writing, risk management measures to prohibit the import of products containing PBDEs are still "being considered," meaning plans to get these chemicals out of products in Canada haven't been finalized. Clear timelines for phasing out the import and use of these products have not been published. [13]

Permanent negative health effects due to exposure to toxic chemicals during the critical window of development *in utero* may occur because:

- *Due to their small size, a fetus absorbs more per unit of body weight than adults. That means a fetus also potentially absorbs higher levels of toxic chemicals than adults in relation to their body size.*
- *Their organ systems and other detoxification mechanisms are less developed than adults, meaning a fetus is not as efficient at flushing out many chemicals.*[16]
- *The blood-brain barrier is not fully developed until after birth.*[17] *The blood-brain barrier separates the circulating blood (which may contain harmful chemicals) from the sensitive brain fluid.*
- *A fetus grows at breakneck speed, which means rapid cellular activities—such as division, proliferation, and growth into specialized cells—are occurring. These developing cells are especially sensitive to chemical exposures.*[18]

Toxic exposures in developing children:

The first study demonstrating that toxic substances passed through the placenta to the developing child was published in 1968.[14] Since that time, DDT, PCBs and other toxics have been banned, and advancements in our understanding of how chemicals affect the developing fetus have been made. This research has demonstrated the particular vulnerability of the fetus to chemical exposures.[15]

This information is troubling, but the exposures continue. In 2005, U.S.-based Environmental Working Group (EWG) published the report *Body Burden: The Pollution in Newborns*, after conducting tests for toxic chemicals in the umbilical cord blood of 10 U.S. babies. The report was followed in 2009 by *Pollution in Minority Newborns,* EWG's study of toxics in the cord blood of 10 minority children in the U.S. The results were startling. The 2005 report found 287 chemicals of the 413 tested[19]; the 2009 report found 232 chemicals present out of the 383 tested.[20]

ENVIRONMENTAL DEFENCE: Investigating Toxic Pollution in Canadians Since 2005

ENVIRONMENTAL DEFENCE has been testing Canadians for toxic chemicals for eight years, in order to demonstrate how pervasive toxics are in our environment. These latest results found 137 toxic chemicals in the umbilical cord blood of three Canadian newborns. In other words, our testing found that babies come out of the womb pre-polluted.

We have tested older children before. *Polluted Children, Toxic Nation* (2006) was the first Canadian study to test for harmful chemicals like PCBs and flame retardants in children's bodies, and the results showed that the bodies of Canadians young and old are polluted regardless of where they live, work, play or go to school. In some cases, the children in the study had higher levels of certain chemicals than their parents.

We can celebrate some successes in Canada since we began working on this issue. When Canada banned BPA from baby bottles in 2010, it was the first jurisdiction anywhere in the world to do so. In banning phthalates from children's toys in 2011, Canada took proactive steps to protect children from these endocrine-disrupting chemicals. Through the *Chemicals Management Plan* (CMP), first established in 2006, over 200 chemicals have been reviewed for safety, including some already in the marketplace as well as new substances.

However, our work is not finished. As our umbilical cord blood tests indicate, we still have a long way to go in protecting Canadians from toxic chemicals. And, even when plans to reduce pollution are announced with the best of intentions, the price of delay is continued exposure to chemicals known to be harmful to human health and the environment.

Canadians spend an average of 90 per cent of their time inside, which means we spend most of our daily lives exposed to chemicals found in common household items and dust.

Environmental Exposures

The dust on your floor, the mattress that you sleep on, the couch in your living room, and the chemicals they contain, are part of your everyday environment. Canadians spend an average of 90 per cent of their time inside. This means we spend most of our daily lives exposed to chemicals found in common household items and dust.

Studies are also finding that these chemicals are ending up in the natural environment, polluting rivers and lakes and ending up in drinking water. Some are known to be toxic to wildlife. Some of these chemicals, such as DDT and PCBs, also remain in the environment years after they have been banned, and are showing up in bodily fluids of Canadians, including the umbilical cord blood of newborns, meaning Canadian babies are born pre-polluted.

SECTION 1 - WHAT OUR TESTING FOUND

Summary

To investigate which heavy metals, carcinogens, and endocrine-disruptors (chemicals that mimic human hormones) are appearing in the umbilical cord blood of Canadian newborns, three expectant mothers from the Greater Toronto and Hamilton Areas volunteered, anonymously, to provide a sample of umbilical cord blood taken at birth for testing by an accredited laboratory.

The three umbilical cord blood samples were taken in February 2013. The blood was prepared with a centrifuge by a phlebotomist at the GAGE Occupational and Environmental Health Unit at the University of Toronto. The samples were then analyzed by AXYS Analytical Services, an accredited lab based in Sidney, British Columbia. The results were then interpreted by ENVIRONMENTAL DEFENCE.

In all three samples, the following chemicals were detected: lead, methylmercury, two dioxins and furans, 10 organochlorine pesticides, 22 PBDEs, and 96 PCBs. In addition, two PFCs were also detected in one of the samples.

ABOUT THE CHEMICALS

DIOXINS/FURANS: two chemicals found across three cord blood samples.

Dioxins are highly toxic and persistent chemicals, and they accumulate in our bodies over time. They are spread through the environment mainly as a by-product of a number of industrial processes, including any combustion process (commercial, medical or municipal waste incineration), burning fuels, chlorine bleaching of pulp and paper, herbicide and pesticide manufacturing, chemical manufacturing, refining and processing of oil, electrical power generation, and iron and steel production. Studies demonstrate that 90 per cent of human dioxin exposure occurs through diet, from the consumption of fish, meat, or dairy products, and that the chemicals accumulate in food chains because they are deposited into the ground and water through the air and rain.[21] Dioxins can cause a number of harmful health effects to humans and animals, including problems with reproduction and development; suppression of the immune system, endocrine system and nervous system; skin disorders such as chloracne; liver damage; elevated incidence of diabetes; heart and kidney disease; and cancer.[22]

PBDEs (POLYBROMINATED DIPHENYL ETHERS): 22 chemicals found across three cord blood samples.

Polybrominated flame retardants (also known as PBDEs) are used with the intention of slowing the spread of fire in upholstered furniture, mattresses, curtains, carpets and electronics. However, studies have shown that they are ineffective at preventing furniture fires, and that the toxic fumes emitted when treated furniture burns pose an even greater health hazard to those exposed, including fire fighters, who consistently show higher rates of cancer than the general population. Some flame

retardants contain PBDEs (polybrominated diphenyl ethers), a group of chemicals that are highly persistent and increase in concentration moving up the food chain. PBDEs are suspected endocrine-disruptors and can cause cancer, and reproductive and developmental disorders. PBDEs are suspected of having particularly damaging effects on the thyroid (which controls fetal brain development), and as a result, PBDEs may cause neurodevelopmental disorders such as learning disabilities and behaviour problems.[23] PBDEs leach from products and have been detected in house dust, human blood and breast milk.[24]

PFCS (PERFLUOROCARBONS): two chemicals found in one cord blood sample.

Perfluorinated chemicals are widely used for their resistance to environmental breakdown in a range of consumer products. PFOS (perfluorooctane sulfonate) is used as a stain repellent on clothing and other fabric products, such as carpets. This chemical is also used in food packaging, particularly for fast food and microwave popcorn bags. Another perfluorinated chemical of concern is PFOA (perfluorooctanoic acid), which is used to make Gore-Tex and Teflon products, such as non-stick cookware. Although much more research is needed on these chemicals, existing studies have shown that perfluorinated chemicals are extremely persistent. Studies also suggest that these chemicals can cause cancer and disrupt hormones.[25]

ORGANOCHLORINE (OC) PESTICIDES: 10 chemicals found across three cord blood samples.

Before they were banned, OC pesticides were mainly used in agricultural crops. These chemicals, the most infamous of which is DDT, are highly toxic and persistent in the environment. Those detected in our study are legacy chemicals from prior applications. As a group of chemicals, OC pesticides have been classified as carcinogenic, and have been reported to cause skeletal abnormalities and reproductive, neurological and immune system damage. Studies indicate that chronic exposure causes damage to the reproductive system resulting in reduced fertility.[26]

PCBS (POLYCHLORINATED BIPHENYLS): 96 chemicals found across three cord blood samples.

PCBs have been banned from production and importation in Canada since 1977, yet they continue to be released into the environment, and from older industrial equipment that is still in use. PCBs are highly toxic and persistent chemicals that build up in wildlife and people through the process of bioaccumulation. PCBs are reported to cause many types of cancer, and damage the nervous, immune and cardiovascular systems, leading to birth defects, brain damage and decreased immune function.[27]

Additionally, some PCB compounds degrade by losing chlorine molecules over time. These lighter compounds are absorbed more readily by humans and they may behave differently in terms of their toxicity.

Of the **137** chemicals found in the umbilical cord blood:

* **132** are reported to cause cancer in humans or animals;
* **110** are considered toxic to the brain and nervous system; and
* **133** cause development and reproductive problems in mammals.

Further, the potential danger of combined exposure to these groups of chemicals has not been adequately studied.

LEAD: Found in all three samples.

Lead is a heavy metal that occurs naturally in the environment and is released in manufacturing and product uses. Most exposures to lead come from lead paint and emissions from industrial facilities like metal smelters. Other sources of exposure include crystal tableware, porcelain enamel, old leaded gasoline, paint, and tire weights. It also appears as a contaminant in lipstick and can contaminate food. Lead is a neurotoxin and endocrine-disruptor, and can damage almost every organ and system in the human body, particularly the nervous system.[29] Lead has been indicated as a cause of decreased mental ability, developmental delays, behavioural disorders and reproductive defects.

MERCURY (METHYLMERCURY): Found in all three cord blood samples.

Mercury occurs naturally in the environment, but the major sources of mercury pollution are coal-fired power plant emissions and emissions from mining and manufacturing processes, as well as mercury-containing products, such as thermometers, batteries, electrical switches and compact fluorescent light bulbs. There is more than one type of mercury. When inorganic mercury enters the air from human sources it is then deposited in soil and water, where micro-organisms transform some inorganic mercury into methylmercury. Methylmercury can bioaccumulate in the fatty tissues of living organisms, particularly fish living in polluted waters, and the people who consume those fish. Mercury is a recognized developmental toxin, and it is also a suspected endocrine-disruptor, neurotoxin, reproductive system toxin and respiratory system toxin.[30]

FINDINGS

Our research found toxic substances from seven different chemical groups that are known to present various potential risks to human health:

* We detected **137 of the 310 chemicals** tested (**45 per cent**) in the cord blood samples from the three babies, with a range of between **55** and **121** for each child. **54** of these chemicals were found.

* Of the **137** chemicals found in the umbilical cord blood, **132** are reported to cause cancer in humans or animals, **110** are considered toxic to the brain and nervous system and **133** cause development and reproductive problems in mammals. Further, the potential danger of combined exposure to these groups of chemicals has not been adequately studied.

When it comes to protecting the most vulnerable among us from exposure to carcinogenic, endocrine-disrupting, hazardous chemicals, the responsibility falls not on the shoulders of mothers, but on society as a whole.

TABLES AND EXPLANATIONS

TABLE 1: Chemicals Tested For and Found in Cord Blood Samples

CHEMICAL GROUP	TOTAL # TESTED	TOTAL # FOUND
Dioxins & Furans	17	5
PBDEs	40	22
PFCs	13	2
OC pesticides	29	10
PCBs	209	96
Heavy Metals	2	2
Total	**310**	**137**

TABLE 2: Some common health effects of the chemical groups present in cord blood

CHEMICAL FAMILY	Cancer	Reproductive toxicity	Developmental toxicity	Neurotoxicity	Endocrine disruption	Immunotoxicity
Lead		X	X	X		
Methyl Mercury				X		
Dixions/Furans	X	X	X	X		X
PCBs	X		X	X	X	X
PBDEs	X	X	X		X	
OC Pesticides	X		X	X	X	X
PFCs	X	X	X		X	

TABLE 3: Toxic chemicals that have been banned or restricted and are still turning up in newborns

CHEMICAL NAME	CHEMICAL GROUP	REGULATION/BAN	DETECTION
4,4'-DDE (DDT)	Organochlorine pesticide	Federal government discontinued registration of all uses in **1985**. Internationally banned from agricultural use by Stockholm Convention in **2004**.	In two cord samples
endosulphan	Organochlorine pesticide	Federal government announced phase-out in **December 2010**, to be complete by **December 2016**	In two cord blood samples
hexachlorobenzene	Organochlorine pesticide	Internationally banned from agricultural use by Stockholm Convention in **2004**	In all three cord blood samples
chlordane	Organochlorine pesticide	Internationally banned from agricultural use by Stockholm Convention in **2004**	In two cord blood samples
perfluorooctane (PFOS) sulfonate	Perfluorinated compound (PFC)	Federal government added PFOS to Virtual Elimination List in **July 2008**	3 congeners detected in all three cord blood samples
tetra-brominated diphenyl ethers (tetra-BDEs)	Polybrominated diphenyl ether (PBDE)	Federal government added tetra-BDES to Virtual Elimination List in **July 2008**	3 congeners detected in all three cord blood samples
penta-brominated diphenyl ethers (penta-BDEs)	Polybrominated diphenyl ether (PBDE)	Federal government added penta-BDES to Virtual Elimination List in **July 2008**	3 congeners detected in all three cord blood samples
hexa-brominated diphenyl ethers (hexa-BDEs)	Polybrominated diphenyl ether (PBDE)	Federal government added hexa-BDES to Virtual Elimination List in **July 2008**	2 congeners detected in all three cord blood samples

trichloro biphenyls*	Polychlorinated biphenyl (PCB)	Federal government banned import, manufacture, and sale of PCBs in **1977**. Banned release into environment in **1985**.	9 congeners detected in all three cord blood samples
pentachloro biphenyls*	Polychlorinated biphenyl (PCB)	Federal government banned import, manufacture, and sale of PCBs in **1977**. Banned release into environment in **1985**.	7 congeners detected in all three cord blood samples
hexachloro biphenyls*	Polychlorinated biphenyl (PCB)	Federal government banned import, manufacture, and sale of PCBs in **1977**. Banned release into environment in **1985**.	4 congeners detected in all three cord blood samples

** In total, 96 different congeners of PCBs were detected in the analysis. Those presented here are the ones with the most frequent detection in the cord blood samples. All PCBs have been banned for importation, manufacture and sale in Canada since 1977.*

SECTION 2 - **WHAT DO THE RESULTS MEAN?**

The chemicals found in the samples tested in this study were detected at low levels. While this study shows low levels of exposure for many chemicals, the results cannot be used to predict how exposure to a chemical will affect the fetus, and the individual later in life. The issue is that the results, especially when compared to similar studies conducted in the U.S., indicate that at no point in our lives are human beings free of exposure to toxic chemicals. What begins *in utero* continues throughout life, and the effects of constant exposure to low levels of heavy metals, carcinogens, and endocrine-disrupting chemicals have not been adequately studied. In addition, very little is known about the potential additive and cumulative effects of these chemicals in our bodies and the environment. More research is required to assess the scale of Canadians' exposure to toxics while *in utero.*

We All Live Downstream

All Canadians live downstream of the history of our industrial society. Decades-old pollution is with us still, in our environment and in our bodies.

These results suggest that everyone is at risk, even from birth. However, some communities may be more at risk than others. Our tests looked at cord blood samples taken from three anonymous newborns in the Toronto and Hamilton Areas. In comparison, living in an agricultural area could mean higher pesticide exposures. Mothers from regions and cultures where fish consumption is a major component of diet, such as some First Nations communities, are more at risk of ingesting mercury. And studies indicate lower income families are often exposed to more industrial pollutants. Every child deserves an equal opportunity to have a healthy start in life, but like exposures, or economic status, risks are not distributed evenly.

More research looking at the human health impacts of exposure to endocrine-disrupting chemicals is needed. However, presently there is more than adequate scientific evidence to indicate a need to reduce exposure to these toxic substances. Currently in Canada, the majority of chemical substances do not require a safety assessment before they enter the marketplace. ENVIRONMENTAL DEFENCE advocates for a risk management strategy which would shift the burden of proof onto industry to prove the safety of a chemical before its introduction or continued use in the market. The approach, known as **the precautionary principle**, implies that in the absence of proof of no harm, a chemical should not be permitted for use in commerce. We have a duty to take steps to prevent further harm when it is within our power to do so.

From PFCs to flame retardants, many chemicals known or suspected to cause cancer, mimic human hormones, and cause developmental and reproductive problems, are in the products we buy regularly. In fact, the President's Cancer Panel report *Reducing Environmental Cancer Risk: What We Can Do Now* (2010), a study into the environmental causes of cancer released under U.S. President Barack Obama, said the risks are "grossly underestimated."[42] All the more reason to demand that companies make it a policy to find safer alternatives to toxic chemicals.

Health effects from exposure *in utero*

While more research needs to be done to fully assess the scale of the problem, studies have shown that babies are more vulnerable to the effects of certain chemicals while developing in the mother's womb, as well as at other windows of development such as infancy and puberty.

Breast tissue is especially susceptible to cancer-causing influences that occur during development in the womb.[31] Animal studies suggested that exposure to endocrine-disrupting chemicals during fetal development can alter the future development of mammary tissue with possible outcomes for breast cancer.[33] Studies indicate PBDEs, lead, PFCs, OC pesticides, and dioxins and furans are endocrine-disruptors.

Un-descended testes (cryptorchidism) in young boys are linked to exposure to PBDEs and pesticide exposure during pregnancy.[33] This condition is also related to *in utero* exposure to phthalates. Rates of un-descended testes have been increasing.[34]

Developmental neurotoxicity (negative impacts on brain development such as decreased alertness, responsiveness and attentiveness) has negative impacts on brain development, such as decreased alertness, responsiveness and attentiveness, is linked to PCB exposure ***in utero***.[35] Developmental exposures can cause changes that may not be evident as birth defects but can result in permanent changes that lead to increased risk of diseases later in life.[36]

Sex ratio imbalances, resulting in fewer male offspring, have been seen in studies looking at both animal and human exposure to dioxins.[37] Developmental exposures to PCBs, lead and methylmercury are associated with cognitive and behavioural deficits such as memory and language skills and inattention in children.[38] Studies have also shown ***in utero*** exposure to mercury to be linked to slower motor function and verbal acuity in teenage years.[39]

Exposure ***in utero*** to both PFOS and PFOA has been demonstrated to result in low birth weight and head circumference at birth, which are factors known to be associated with greater susceptibility to chronic disease later in life.[40]

Studies looking at levels of PBDEs in cord blood found those infants with higher concentrations had decreased levels of thyroid hormone, which is crucial for normal brain development and metabolic regulation.[41]

More Action is Needed—Urgently

The good news is that some of the chemicals we tested for have been banned. Organochlorine pesticides, such as DDT, can no longer be sprayed on Canadian fields, and PCBs cannot be imported or produced.

Through reviews conducted by the *Chemicals Management Plan* (under the auspices of the Canadian Environmental Protection Act (CEPA, 1999), and/or under international treaty obligations, such as the Stockholm Convention on Persistent Organic Pollutants (POPS), decision makers are reviewing some of the most toxic substances, and considering how to regulate them.

But that doesn't mean toxic substances are no longer a cause for concern. As our results indicate, chemicals persist in the environment, and in people, long after they are banned. This makes the case for banning toxic substances still in the marketplace now all the more urgent.

For example: PCBs were banned from production and importation in Canada in 1977, yet 96 of these chemicals turned up in our samples.

Many PBDE flame retardant chemicals have also been banned from importation, but although additional regulations to reduce PBDEs in products were announced in 2010, these steps have yet to be finalized.

Our results indicate chemicals persist in the environment, and in people, long after they are banned, which makes the case for banning toxic substances still in the marketplace now all the more urgent.

Flame retardants and the law

The laws that apply to flame retardants and flammability are complex, and some regulations will likely be changing in the near future. California has North America's strictest flammability standard, TB117 (a technical test required by California to assess flammability), but it has been shown to be ineffective at preventing house fires because the test does not reflect how fires actually start. However, because of this standard, furniture makers use tons of toxic flame retardant chemicals to make their products eligible for sale in California, as well as elsewhere in North America. Rather than make multiple types of a product, one heavily treated product is often made for sale across the U.S. and Canada. But in February 2013, California Governor Jerry Brown announced that the state would be changing TB117 so as not to require the use of toxic flame retardants in furniture.

Canada also has laws that set flammability standards for textiles, based on the amount of time it takes for a flame to spread through material. Some fibres such as wool and bamboo are naturally flame resistant, without the addition of chemical treatments. Silk and nylon are also difficult to ignite, and may self-extinguish after the removal of the ignition source.

PCBs were banned from production and importation in Canada in 1977, yet 96 of these chemicals turned up in our samples.

Toxic Pollution in Our Everyday Environment

In 2013, the UN Environment Programme (UNEP) and the World Health Organization (WHO) released a joint report: *State of the Science of Endocrine-Disrupting Chemicals.* The report is a comprehensive review of recent science on endocrine-disrupting chemicals. These chemicals (aka hormone-disrupting chemicals) include phthalates, an additive to plastics and cosmetics.

The report warns that many chemicals found in household and industrial products could lead to significant health issues due to their disrupting effect on the human hormonal system. Many of these chemicals are now widespread, though they have not been adequately tested for safety and health effects.

Bolstering calls for action from concerned scientists, medical professionals, and environmental health advocates, the report highlights associations between exposure to endocrine-disrupting chemicals and health problems such as breast cancer, thyroid cancer and prostate cancer as well as attention deficit disorder and hyperactivity in children.

This is significant because in recent decades there have been spikes in the rates of young women with thyroid cancer (up by five per cent per year between 1981 and 2009)[43], and rates of young men with testicular cancer (up by 44 per cent between 1973 and 1998 in U.S. males).[44] Some scientists have expressed concern about possible links between endocrine-disrupting chemical exposures and the increase in cases of testicular cancer. It is clear that now is the time to take action to help protect human health.

RECOMMENDATIONS

RECOMMENDATIONS FOR CANADIANS

Avoiding Exposure:

Some of the toxic chemicals in this report are more easily avoided than others. Use ENVIRONMENTAL DEFENCE'S **Toxic Nation** tips and guides, as well as guides produced by health agencies to avoid some of the worst offenders in household products as well as food. Visit **environmentaldefence.ca/issues/toxic-nation** for more information.

Canadians can help reduce their exposure to toxic chemicals by avoiding products which contain PFCs and brominated flame retardants. Instead, purchase furniture, carpeting and draperies made of organic or natural fibre carpets, such as wool, rattan or jute. Also avoid non-stick cookware because it could contain PFCs.

Regular vacuuming and airing out of the home can help reduce the amount of dust, which is a key source of exposure to PBDEs (brominated flame retardants), and PFCs.

To avoid mercury, the City of Toronto has produced a helpful guide regarding mercury in fish, and how to reduce your exposure. The guide can be found here: **toronto.ca/health/hphe/fish_mercury.htm**.

What You Can Do to Make a Difference:

Join ENVIRONMENTAL DEFENCE in calling for bans on toxic substances in products, and in our calls for industry to use less polluting substances in products. Sign our petitions to government and industry at **environmentaldefence.ca/take-action**.

Join **Team Toxout** to stay informed of new developments in the science around toxic chemicals, and to participate in our campaign to take out the toxics. By signing up for our monthly newsletter, you will learn of calls to action and tips for reducing your exposure to toxic chemicals. You can sign up at **environmentaldefence.ca/newsletter-sign**.

RECOMMENDATIONS FOR GOVERNMENT

ENVIRONMENTAL DEFENCE is calling upon the federal government to:

1. Ban harmful chemicals from products. For chemicals for which phase outs have been announced, the government should establish clear, strict timelines for removing these chemicals from the marketplace. Specifically this includes implementing bans on PBDEs (polybrominated diphenyl ethers) in products and perfluorinated chemicals (PFCs) that have not yet been phased out, including PFOA (perfluorooctanoic acid), and to conduct research into and promote safe substitutions for these and other toxic chemicals.

2. Test chemicals used in consumer products for toxic effects before they can be sold to Canadians. This is consistent with the precautionary approach the EU is taking to protect its citizens.

3. Expand and expedite research into the toxic body burden of newborns in Canada to scientifically assess the scale of the issue. Health Canada should expedite publication of studies relevant to toxic body burden of Canadian children, and where applicable, newborns.

4. Establish clear, reliable and strict timelines between the assessment of toxic substances and remedial action to prevent the substances from entering the environment.

RECOMMENDATIONS FOR INDUSTRY AND BUSINESS LEADERS

ENVIRONMENTAL DEFENCE urges industry and business leaders to:

1. Move ahead of planned phase outs, and continue to act in the absence of existing bans, by removing hazardous substances from products. Brominated flame retardants should be removed from the marketplace in order to protect the health of consumers. for companies using toxic flame retardant chemicals in manufacturing, and in products, ENVIRONMENTAL DEFENCE calls upon business leaders to move to stop using these chemicals, and where necessary, to find safe substitutions.

2. Remove perfluorinated chemicals (PFCs) from manufacturing and in products and where necessary, find safe substitutions.

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APPENDIX

METHODOLOGY

Cord blood sample collection:

ENVIRONMENTAL DEFENCE recruited three pregnant volunteers from the Greater Toronto Area and Hamilton area in January of 2013 to obtain cord blood from their newborns. All births took place in February 2013. The cord blood sample was collected by the attending midwife, nurse, or doctor immediately following delivery. Samples consisted of a minimum of 100 millilitres (mL) of cord blood and 35 mL of citrate-phosphate-dextrous (CPD) anticoagulant in a 250 mL Baxter Fenwal Blood-Pack unit. The 35 mL of CPD anticoagulant consisted of 921 mg sodium citrate, 893 mg dextrose, 105 mg citric acid and 78 mg of monobasic sodium phosphate. Samples were transported on ice to GAGE Occupational and Environmental Health Unit laboratory at the University of Toronto, where a portion of the cord blood was centrifuged by a lab technician to obtain serum for analysis of DX/Fs, PCBs, PFCs, PBDEs and OC pesticides. Each sample was then frozen at -20 degrees Celsius and stored until all three samples were collected. These were then shipped with gel ice packs from the lab in Toronto to AXYS Analytical Services in Sidney, BC, for analysis.

Sample preparation:

AXYS took multiple sub-samples of blood for secondary laboratory analyses (serum % lipid and metals) and AXYS analyses of dioxins/furans, PCBs, PBDEs, OC Pesticides and PFCs). Amber glass vials of serum and plastic tubes of whole blood as appropriate were submitted to each lab for analysis. Sub-samples were stored at -20 degree Celsius prior to secondary labs' shipments or prior to extraction and analysis at AXYS.

Sample extraction:

Samples were analyzed in two batches. Each batch had its own QC including a procedural blank and a spiked matrix sample.

Analysis of Chlorinated Dioxins and Furans - AXYS Method MLA-017:

Samples were spiked with a suite of isotopically labeled PCDD/F surrogate standards prior to analysis, then solvent extracted and cleaned up on a series of chromatographic columns. The extract was concentrated and spiked with an isotopically labeled recovery (internal) standard. Analysis was performed using a high-resolution mass spectrometer coupled to a high-resolution gas chromatograph equipped with a DB-5 capillary chromatography column (60 m, 0.25 mm i.d., 0.1 µm film thickness). All procedures were carried out according to protocols as described in EPA Method 1613B, with some additional internal AXYS guidelines applied.

Analysis of Polychlorinated Biphenyls (PCBs) - AXYS Method MLA-010:

Samples were spiked with isotopically labeled PCB surrogate standards prior to analysis, then solvent extracted and cleaned up on a series of chromatographic columns. The final extract was spiked with isotopically labeled recovery (internal) standards prior to instrumental analysis. Analysis of the extract was performed on high resolution mass spectrometer (HRMS) coupled to a high-resolution gas chromatograph (HRGC) equipped with a SPB-Octyl chromatography column (30 m, 0.25 mm i.d., 0.25 g film thickness). The method was carried out in accordance with the protocols described in EPA Method 1668A with some additional internal AXYS guidelines applied.

Analysis of Brominated Diphenylethers (PBDEs) - AXYS Method MLA-033:

Samples were spiked with isotopically labeled BDE surrogate standards prior to analysis, then solvent extracted and cleaned up on a series of chromatographic columns. The final extracts were spiked with isotopically labeled recovery (internal) standards prior to instrumental analysis. Analysis of extracts was performed on a high-resolution mass spectrometer (HRMS) coupled to a high resolution gas chromatograph (HRGC) equipped with a DB-5HT chromatography column (30m, 0.25 mm i.d., 0.10 µm film thickness). The method was carried out in accordance with the protocols described in EPA Method 1614 with some additional internal AXYS guidelines applied.

Analysis of Organochlorine Pesticides (OC Pesticides) - AXYS Method MLA-028:

Samples were spiked with isotopically labeled BDE surrogate standards prior to analysis, then solvent extracted and cleaned up on a series of chromatographic columns. The final extracts were spiked with isotopically labeled recovery (internal) standards prior to instrumental analysis. Analysis of extracts was performed on a high-resolution mass spectrometer (HRMS) coupled to a high resolution gas chromatograph (HRGC) equipped with a J&W DB-5 chromatography column (60m, 0.25 mm i.d., 0.10 µm film thickness).

Calculations for Dioxin, Furans, PCBs, PBDEs, and OC Pesticides:

Target concentrations for each analysis were determined by isotope dilution or internal standard quantification procedures using Micromass OPUSQUAN and/or MassLynx software. Sample specific detection limits (DL's) were determined from the analysis data by converting three times the height of the average noise signal to a response, using the area/height ratio of the labeled standard, and then to a concentration following the same procedures used to convert target peak responses to concentrations. If the OPUSQUAN or MassLynx software selected an unrepresentative area for the detection limit calculation, the data interpretation chemist or the QA chemist made corrections.

Analysis of Perfluorinated Chemicals (PFC) - AXYS Method MLA-042:

Samples were spiked with isotopically labeled PFC surrogate, extracted in diluted formic acid and cleaned up on SPE cartridges. Samples were analyzed by liquid chromatography/mass spectrometry (LC-MS/MS). Analysis of sample extracts for perfluorinated organics was performed on a high performance liquid chromatograph column (Waters Xterra MS Reverse phase C18, 10.0cm, 2.1mm i.d., 3.5 um particle size or equivalent) coupled with a triple quadrupole mass spectrometer, running MassLynx v.4.1 software. Final sample concentrations were determined by isotope dilution/internal standard quantification against matrix calibration standards carried through the analysis procedure alongside the samples.

Calculations for PFCs:

Target concentrations for each analysis were determined by isotope dilution or internal standard quantification procedures using Micromass MassLynx software. Sample specific detection limits (DL's) were determined from the analysis data by converting three times the height of the average noise signal to an area using the area/height ratio of the labeled standard, and then to a concentration following the same procedures used to convert target peak responses to concentrations. If the MassLynx software selected an unrepresentative area for the detection limit calculation, the data interpretation chemist or the QA chemist made corrections. Reporting limits were equal to the greater of the lowest calibration standard concentration equivalent or the sample specific detection limit (SDL).

Analysis of Lead:

Whole blood samples were diluted 50x with a one percent HNO3. Digests are analyzed using Inductively Coupled Plasma: Mass Spectrometry (ICP-MS) for the analysis of Lead (Pb). Results were blank corrected as per Brooks Rand SOPs for EPA 1638 Modified method.

Analysis of Monomethyl Mercury:

Blood samples were prepared by potassium hydroxide/ methanol (KOH/MeOH) digestion followed by distillation. All samples were analyzed by aqueous phase ethylation, Tenax trap pre-concentration, gas chromatography separation, pyrolytic combustion and atomic fluorescence spectroscopy (CV-GC-AFS) using a Brooks Rand Labs MERX-M analyzer. The samples were analyzed by a modification of EPA Draft Method 1630, as detailed in the BRL SOP BR-0011. Results were blank corrected as per Brooks Rand SOPs.

QA/QC:

All organic analyses were conducted in accordance with AXYS' accredited QA/QC program including regular analysis of QC samples and participation in international inter-laboratory comparison programs. Each analysis batch included a procedural blank to demonstrate cleanliness and a spiked laboratory control sample to monitor precision and recovery. The sample results were reviewed and evaluated in relation to the QA/QC samples worked up at the same time. The sample surrogate standard recoveries and detection limits, procedural blank data and the laboratory control sample data were evaluated against method criteria to ensure acceptable data quality.

The laboratory flagged some values for not meeting certain analytical criteria. These related to ion abundance ratios and the method calibration limit. We used these values but note the data quality flags. We counted each of the co-eluting chemicals and reported them as individual chemicals, as is standard practice.

environmental
defence

116 Spadina Avenue, Suite 300
Toronto, Ontario M5V 2K6
tel **416-323-9521** fax **416-323-9301**
email **info@environmentaldefence.ca**

www.environmentaldefence.ca