NATIONAL TOXICS NETWORK

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Children's Environmental Health - Intergenerational Equity in action

"*Children are not just little adults….they are more vulnerable than adults. They eat more food drink more water and breathe more air as a percentage of their body weight than adults and as a consequence they are more exposed to the chemicals present in food water and air" Children are growing and developing and may therefore be physiologically more susceptible than adults to the hazards associated with exposures to chemicals"*

- US National Academy of Sciences [1]

" Children are not little adults: they have special vulnerabilities to the toxic effects of chemicals. Children's exposure to chemicals at critical stages in their physical and cognitive development may have severe long-term consequences for health. Priority concerns include exposure to air pollutants, pesticides and persistent organic pollutants (POPs), lead, mercury, arsenic, mycotoxins and hazardous chemicals in the workplace."

– WHO, ILO, UNEP [2]

The Problem

Since World War II, approximately 80,000 new synthetic chemicals have been manufactured and released into the environment, with approximately 1500 new chemicals being introduced each year. The vast majority of these have not been adequately tested for their impacts on human health or their particular impacts on children and the developing foetus. Yet, children are exposed to hazardous chemicals through residues in their food, indoor and outdoor air pollution, and through household products and contaminated house dust. Many of these synthetic chemicals are persistent and bioaccumulative, remaining in the human body long after exposure. The developing foetus takes in toxic chemicals that have bioaccumulated in the mother's body and that readily cross over placental barrier. Babies are now born with many man made chemicals already present in their small bodies.[3] A newborn then takes more in through breastmilk or formula. There are no tests to assess the combined impacts of the 'chemical soup' that children are exposed too.

A 2002 Report by the World Health Organization (WHO), the United Nations Children's Fund (UNICEF) and the United Nations Environment Program (UNEP) identified a growing number of children's health impacts caused by exposure to hazardous chemicals. These include asthma, birth defects, hypospadias, behavioural disorders, learning disabilities, autism, cancer, dysfunctional immune systems, neurological impairments, and reproductive disorders.

The WHO has stated that approximately 3 million children under the age of five die every year, due to environmental hazards and this is not limited to developing countries. All children, both in the developing and developed world are affected by exposure to hazardous chemicals. In 2004, the European Union's Ministerial Conference on Children's Environmental Health identified air pollution, unsafe water conditions and lead exposure as the main culprits in the death and disabling of children in Europe. The Conference found that by reducing exposure to hazardous chemicals, the lives of many children could be saved.

A Child's Unique Vulnerability to Chemicals

The unique vulnerability of children to hazardous chemicals is well recognised by the World Health Organisation (WHO), the United Nations' Children's Fund (UNICEF) and its Environment Program (UNEP).[4] Research from the University of California, published this year,[5] has shown that newborn children can be up to 164 times more vulnerable than adults to the commonly used organophosphate pesticide, chlorpyrifos and up to 65 times more sensitive to diazinon.

Children are not simply 'little adults'. Their bodies are still developing and their detoxification systems are immature. They react to hazardous chemicals differently from adults.[6] They are also more at risk because they have a higher respiration and metabolic rate than adults, they eat and drink more per bodyweight, they live life closer to the ground, crawling, digging in dirt and putting objects in their mouths. In the debate about the level of risk to children, there is a strong focus on the regulatory decisions about how much dirt a child eats per day ('pica event'). Australia assumes 100 milligrams per day while the U.S. Environmental Protection Agency (US

EPA) factors in the much larger soil ingestion of up to 5 grams. Being unaware of chemical risks, children are less able to protect themselves from exposures and the higher skin absorption rate may also result in a proportionally greater exposure.

A child's detoxification systems and ability to excrete toxins also differs from adults. While at times this can offer greater protection it can also increase vulnerability, for example where a metabolite is more toxic than the original contaminant. Should the enzyme systems responsible for detoxification be damaged early in life, the result can be a lifetime of disabling chronic illness. The timing of chemical exposures is also significant. Recent research has shown that babies and children experience particular “windows of susceptibility”[7] in their development. If exposures occur during critical times, it may contribute to health problems much later in life; for example, exposure to dioxin in utero can produce disabilities in neurological function and learning ability well into childhood.[8]

Similarly, it has long been known that lead can cause delinquency and reduced IQ.[9] New evidence links even low levels of lead (that is, the current "acceptable" level of 10 micrograms per decilitre) with an average loss of 7.4 IQ points by comparison with pre-school children whose lifetime average blood lead concentrations remained at 1 microgram per decilitre.[10] In addition to the known links with hearing loss, poor reading, writing and maths ability, reduced life-time earnings and reduced growth, balance and proprioreception (spatial sense of body) problems etc, childhood lead exposure has also been linked with osteoporosis later in life,[11] and foetal lead exposure is now thought to be a contributing factor of schizophrenia.[12]

Early exposure to other endocrine disruptors can affect an individual’s immune function or ability to reproduce. The US Centers for Disease Control and Prevention has reported an increase in the percentage of severe cases of hypospadias.[13] One causal factor being investigated is hormone disruption (in the form of reduced testosterone) caused by synthetic endocrine disrupting chemicals, at a critical time in the foetus’s development. Studies also suggest that early exposure to carcinogens can increase the risk of developing cancer later in life.[14]

The EU has launched a new 5 year 15 million euro research project to investigate exposure to chemicals in food and the environment and their connection with childhood cancer and immune disorders.[15] The study will examine maternal exposure during pregnancy to carcinogenic and immunotoxic chemicals and their effect on young children after they are born.

Is there a problem for Australian children?

While there has been very limited assessment of chemical exposure of Australian children, there is clear evidence of widespread contamination of children in the EU, UK and USA. Childhood cancers are increasing in the developed world, including Australia, where the incidence of asthma is also escalating. Studies in the Europe and the U.S.[16] have identified a wide range of chemicals in umbilical cord blood as well as in children. They include artificial musks, alkylphenols, bisphenol-A, brominated flame retardants, perfluorinated compounds, phthalates, and triclosan. All are found in the common products used every day in the home and school; products like cleansers, computers, toys, lotions and perfumes, cookware, clothing and carpets.

Some like the perfluorochemical, perfluorooctanesulfonate (PFOS) and pentabrominated diphenylethers (PentaBDE) are currently being assessed for inclusion in the *Stockholm Convention on Persistent Organic Pollutants* (POPs) 2001.

The US based Centers for Disease Control and Prevention have been tracking human exposure and recently released their second National Report on Human Exposure to Environmental Chemicals.[17] The report presents exposure data from 1999-2000 for 116 chemicals and concluded that some chemicals like the phthalates, are now at levels in the human population at which you would expect health impacts. There is particular concern for babies, children and women of childbearing age.

While in Australia, little routine monitoring or testing of baby or children's blood has occurred, in 1998, doctors at Townsville Hospital tested the meconium (first bowel discharge) of 46 newborn babies and found a wide range of hazardous chemicals including POPs and pesticides such as chlorpyrifos.[18] Earlier in the 1990s, an Australian paediatrician concerned with a chronic illness in a group of children tested their blood for levels of POPs, persistent bioaccumulative toxins (PBTs) and other volatile compounds. A range of chemicals was detected in all the children's samples, including POPs pesticides, PCBs, hexachlorobenzene (HCB), benzene and toluene.[19]

Estimates based on the Human Health Risk Assessment of Dioxins for the National Dioxin Program indicated that breastfed Australian infants are consuming many times the Tolerable Monthly Intake for dioxins and furans. In 2002, Australia recommended a Tolerable Monthly Intake (TMI) for Australians of 70 picograms of dioxin TEQ per kilogram of bodyweight per month.[20] At a crucial time in their development, 3 month old breastfed babies are consuming at least 16 times the TMI of total dioxins.

Recent testing of the polybrominated diphenyl ethers (PBDEs) and perfluorochemicals have shown contamination of both Australian blood and breastmilk with the highest levels of PBDEs found in young children.[1]

Persistent Bioaccumulative Toxins of Concern

The following persistent bioaccumulative toxins need, as a priority, to be surveyed in Australian umbilical cord blood, meconium and breastmilk.

- **Dioxins** - by-products of PVC, industrial bleaching, and incineration, can cause cancer and are toxic to the hormone system. **PCBs** once used in industrial insulators, accumulate up food chain and cause cancer and nervous system problems. Dioxins and PCBs are listed in the international *Stockholm Convention* for reduction and eventual elimination. Australia has released its National Dioxin Plan which we consider is very weak on action.

[1] Toms L, Harden F, Hobson P, Papke O, Ryan J and Mueller J 2006, *Assessment of concentrations of polybrominated diphenyl ether flame retardants in the Australian population: levels in blood*, Australian Government Department of the Environment and Heritage, Canberra.

- **Brominated Flame Retardants /** polybrominated diphenylethers (PBDEs) **-** used by the electronics industry and in a wide range of products including computers, white goods, car interiors, carpets and carpet underlay, polyurethane foams in furniture and bedding. Some PBDEs have been shown to disrupt thyroid hormones, mimic oestrogen, and are linked with cancer and reproductive damage.[21] Deca-BDE has recently been shown to have the potential to break down in the environment and in animals to the smaller, more toxic penta-BDE that is more bioaccumulative in the environment.[22] PBDEs have now been found in umbilical cord blood, breast milk, breast fat, as well as adult blood and fat.[23] A study[24] of PBDEs in Australian adult blood found concentrations higher than those reported from Europe, UK and Japan. Similar high levels of PBDEs were found in Australia breastmilk.[25] A Norwegian PBDE study found higher levels in 4-year-olds than in adults.[26] PBDEs have also been detected in house dust from 27 homes [27] up to 25,000 ppb due to off gassing of treated products and furnishings. 'Wipe samples' from computers contained PBDEs in all sample.[28] PentaBDE has been nominated as a new POP and is currently being assessed by the *Stockholm Convention's* Persistent Organic Pollutants Review Committee.

- **Perfluorochemicals -** Perfluorooctanesulfonate (PFOS)/ Perfluorooctanoic acids and their precursors. PFOS was the active ingredient in the Scotchguard Stain Protection and is now used in coatings in photography and microelectronics, and in some specialised fire fighting foams. PFOA is used in the production of fluoropolymers for non-stick cookware coatings and in the manufacture and treatment of textiles. PFOAs may also form as degradation products of small polymers called telomers used in soil, stain and grease resistant coatings on carpets, textiles, paper, and leather. PFOS is a reproductive toxin and PFOA is a likely carcinogen. Both persist in the environment forever ('terminal product'), accumulating in human and animals. Many other perfluorochemicals break down to either PFOS or PFOA. The OECD Joint Chemicals Meeting 2002 reported [29] that PFOS was detected in the blood of nearly 600 US children, aged from 2-12 years. Recent testing has shown that PFOS and PFOA concentration in the blood of adult Australians is high compared to studies in other countries.[30] The USEPA review of PFOA used in Teflon manufacture, [31] found that it accumulates in the blood system and poses a risk for childbearing women. According to their preliminary risk assessment, the estimated exposure range for humans, based on rat studies, has already overlapped with what the USEPA deem as unacceptable for toxic substances. While PFOS is restricted in Australia to essential uses in fire fighting industry, PFOA is subject to only voluntary action. PFOS has been nominated as a new POP and is currently being assessed by the *Stockholm Convention's* Persistent Organic Pollutants Review Committee.

- **Organophosphate insecticide metabolites-** metabolites of organophosphate pesticides eg, chlorpyrifos. Organophosphates are severe neurotoxins and damage the central nervous system. The USEPA review of chlorpyrifos acknowledged that the insecticide and its metabolites had been found in the urine of 89% of children tested in one US study.[32] Dow AgroSciences' 1998 data showed the chlorpyrifos metabolite, TCP-3,5,6-trichloro-2-pyridinol in 100% of a sample of 416 US children (0-6 years).[33] In 1998, a study in regional Australia had shown chlorpyrifos was present in the meconium (first bowel discharge) of 59% of new-born babies.[34] Chlorpyrifos is widely used both in agriculture and for termite and insect control.

- **Phthalates** – used as plasticizers or softening agents in vinyl products, including furnishings, flooring coverings, medical devices (eg catheters, IV- and blood bags), babies feeding bottles, toys, teething rings, food wrap, cosmetics, perfumes, soaps, lotions and shampoos, and are also added to insecticides and adhesives. Diethylhexyl phthalate (DEHP) has been shown to migrate into food from certain food wraps during storage. Some phthalates are hormone disruptors,[35] immunotoxins,[36] cancer promoters and are reproductive and developmental toxins.[37] DEHP has been classified as a "probable human carcinogen" by the USEPA. Phthalates have been detected in the blood and urine of children in the US and the EU. The presence of pthalates in children's toys, teethers and dust containing phthalates may indicate that children are at particular risk. The US National Toxicology Program (NTP) have expressed concern over the adverse development of babies born to pregnant women who are exposed to DEHP, the most widely used phthalate plasticizer at the normal levels estimated for an adult.[38] In 2006 NICNAS declared 11 phthalates priority existing chemicals.

- **Artificial Musks –** nitromusks (musk xylene, musk ketone) and polycyclic musks (tonalide (AHTN), galaxolide (HHCB).) are used to replace natural aromas in products like washing agents, soap and cosmetics They are found in breast milk, blood and fat, and can induce **e**nzymes and disrupt hormone. They are linked to hormonal and gynaecological problems in women. Musk ambrette banned in EU cosmetics since 1995 has recently been found in EU maternal blood and cord blood samples.[39]

- **Alkylphenols (APs) -** nonylphenols (NPs), octylphenols (OPs), nonylphenol ethoxylates (NPEs) are used in plastics, industrial detergents and emulsifiers, textile and carpet cleaning, most can degrade back to Alkylphenols APs, which are persistent, bioaccumulative and have been found in umbilical cord blood and breast milk. NPs have also been found in foods, rainwater and in house dust. Alkylphenols can mimic oestrogen hormones and in test animals alter sexual development in fish and sperm quality in mice.[40]

- **Triclosan** (5-chloro-2-(2,4-dichlorophenoxy)phenol) - is used in toothpastes, acne creams, deodorants, lotions, and hand soaps, and is incorporated into a wide range of consumer goods, including kitchen tiles, children's toys, cutting boards, toothbrush handles, hot tubs, and athletic clothing. Triclosan is linked to skin irritation, (photoallergic contact dermatitis), allergy susceptibility and effects on the body's thyroid hormone metabolism. Triclosan is weakly androgenic, causing changes in sex ratios in fish. It bioaccumulates in fatty tissue and has been found in Swedish samples of human breast milk. New research[41] suggests that triclosan can react with chlorinated water to produce carcinogenic chloroform and dioxins. Triclosan was found in 50% of umbilical cord blood samples. National Industrial Chemical Notification and Assessment Scheme (NICNAS) declared triclosan a priority existing chemical in 2003 and initiated a breast milk study of Australian mothers.

- **Organochlorine pesticides** - include the persistent organic pollutants; DDT, dieldrin, aldrin, endrin, heptachlor, chlordane and mirex (still used in NT), OCs accumulate up food chain, can cause cancer and reproductive effects. All except mirex are banned in Australia.

- **Volatile and semi-volatile organic chemicals (VOCs)** – are industrial solvents found in petrol, paints and household products. They are toxic to nervous system toxic and some like benzene cause cancer.

- **Metals** - lead, organomercury, organotin from industrial emissions, food residues, lead in paint and leaded petrol, can cause mental retardation, learning disabilities

International programs

The WHO has been working on a children's environmental health since 1999 when it established the Taskforce for the Protection of Children's Environmental Health. In 2002 WHO launched its Healthy Environments for Children Alliance (HECA) at the World Summit for Sustainable Development. HECA has developed the HECA Framework for Action for global action to protect children's environmental health.

The United Nations Children's Fund (UNICEF) is a member of HECA and through its program on water, environment and sanitation, attempts to protect the environment for children's health.

The United Nations Environment Program (UNEP) has also been active in children's environmental health issues working closely with UNICEF and the WHO. UNEP is a core member of HECA and also serves as the Secretariat for many chemical conventions. In this role, they have been able to work with governments to help ensure that children's environmental health issues are addressed in the development of international agreements on chemical management. In the *Stockholm Convention on Persistent Organic Pollutants* 2001, children and their specific needs are referred to, for example, in Article 7 on implementation, parties are oblige to consult their national stakeholders, including women's groups and groups involved in the health of children.

Protecting children was also a focus of the recently developed Strategic Approach to International Chemical Management (SAICM). The High Level Declaration adopted at the International Conference on Chemical Management held in February 2006 state that the signatories *"are determined to protect children and the unborn child from chemical exposures that impair their future lives"* and the Over Arching Policy Strategy's Statement of Need acknowledged that *"risk reduction measures need to be improved to prevent the adverse effects of chemicals on the health of children, pregnant women, fertile populations, the elderly, the poor, workers and other vulnerable groups and susceptible environments"*. Unfortunately, some of the activities associated with the SAICM Global Plan Of Action relating to the section on Children and Chemical Safety were blocked by the US and a small number of countries. Of particular concern were the activities regarding the chemical composition of children's products and toys. International actions to stop manufacturers '*marketing products containing substances that have or may have adverse effects on children's health'*, for example phthalates of concern and certain fragrances, were blocked.

Since 2000, a number of international reports on children's environmental health[42] have been prepared including a review of children's health and environment, undertaken by the WHO, European Environment Agency, UNEP, UNICEF and the Intergovernmental Forum on Chemical Safety (IFCS).

In 2003, the Fourth Session of the IFCS held in Thailand and attended by 126 governments, agreed on a range of actions and recommendations to protect children from chemical exposure**.**[43] These included:

- the assessment of chemical exposures during preconception, throughout gestation, infancy, childhood and adolescence;
- government initiated multi-stakeholder consultation in national assessments of children's environmental health and chemical safety to identify priority concerns and provide a basis for developing action plans to address risks. Government should provide a progress report to Forum V;
- Governments, WHO and UNICEF promotion of education and training on children's chemical safety, and where risks are identified, governments and stakeholders should commit to taking action to prevent or reduce exposure; and
- harmonized data collection, research, legislation and regulations, and consideration of indicators of children's environmental health, and report back to Forum V in 2006. .

Most importantly, Governments should take into consideration the potential enhanced exposures and/or vulnerabilities of children when setting acceptable levels or criteria related to chemicals.

Many non government organisation (NGOs) also have children's environmental health initiatives. The International Network for Children's Health, Environment and Safety (INCHES) is an international forum focused on children's environmental health. It aims to increase understanding of how environmental factors influence child health, to facilitate information exchange on the best practices and policies in children's environmental health, to stimulate new research; and to advocate for children's environmental health in the intergovernmental arena. INCHES won the 2006 Children's Environmental Health Recognition in recognition of its development of training material on children's environmental health for different target groups, including public health and pediatrics professionals.

Legislating for Children

Few countries have legislated to protect children's environmental health although a number like Canada and EU are investigation new options. However, the United States has implemented legislation, *The Children's Environment Protection Act 1997* which aims to protect children from exposure to environmental pollutants. The Act requires that USEPA standards be set at levels that protect children and other vulnerable groups including the elderly, pregnant women, people with serious problems and others. Children are defined as 18 years of age and under.

The legislation requires the USEPA to consider all environmental health risks to vulnerable sub populations in risk assessments, environmental and public health standards and regulatory decisions. The Act also requires the development of a list of USEPA recommended 'safer for children' products and chemicals that minimise potential risks to children. The USEPA has set up a Specialist Office of Children's Health Protection in order to set health standards to ensure the protection of children and vulnerable sub populations. The statutory Children's Health Protection Advisory Committee has as one of its objectives the making of annual recommendations to the USEPA on standards that need re-evaluation.

A number of State Acts support these moves; for example, the Washington State Children's Pesticide Right-to-Know Act (SSB 5533). This Act requires that school districts post notices warning students and staff whenever pesticides are used in and around schools, and provide advance notification to interested parents.

Regulations under the US Residential Lead-Based Paint Hazard Reduction Act of 1992- Title X, require the disclosure of lead-based paint hazards in target housing which is offered for sale or lease. The preamble to the Act states that "low-level lead poisoning is widespread among American children, afflicting as many as 3,000,000 children under age 6" and "the health and development of children living in as many as 3,800,000 American homes is endangered by chipping or peeling lead paint, or excessive amounts of lead-contaminated dust in their homes."

Next Steps in protecting Children's Environmental Health in Australia

Persistent bioaccumulative toxins represent a real and urgent threat to children's environmental health and our obligations to Intergenerational Equity.[44] In the face of current chemical body load of children in the developed world, urgent and precautionary responses are required from government, industry and the community.

Recommendations for Action :

- Establishment at a national level of a specialist office for Children's Environmental Health.
- Establishment of national and State legislation for a Child Environment Protection Act;
- Priority review of all uses of persistent bioaccumulative toxins/PBTs including poly/perfluorochemicals, brominated flame retardants, phthalates and metals to identify both their intergenerational impacts and appropriate regulatory responses.
- An immediate ban of penta and octaBDE, with an accompanying phaseout of decaPBDE over 2 years;
- An immediate ban on PFOS, PFOAs and their precursors;
- Establish ongoing biomonitoring of PBTs in children's blood and urine, in breastmilk and in infant meconium and cord blood;
- Phase out chlorpyrifos and other organophosphates detected in children's meconium;
- Introduce legislation to warn home-buyers and potential tenants of asbestos and lead hazards in houses prior to sale or rent.

- Set a new target for blood lead levels below 10 micrograms per decilitre before 2010 and carry out an initial national blood lead survey (all ages) by 2005 to determine the baseline and set priorities for achievement of the new target.

Endnotes

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[44] 72 Section 3.5.2 of Agenda 21 defines intergenerational equity as: the present generation ensuring that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.