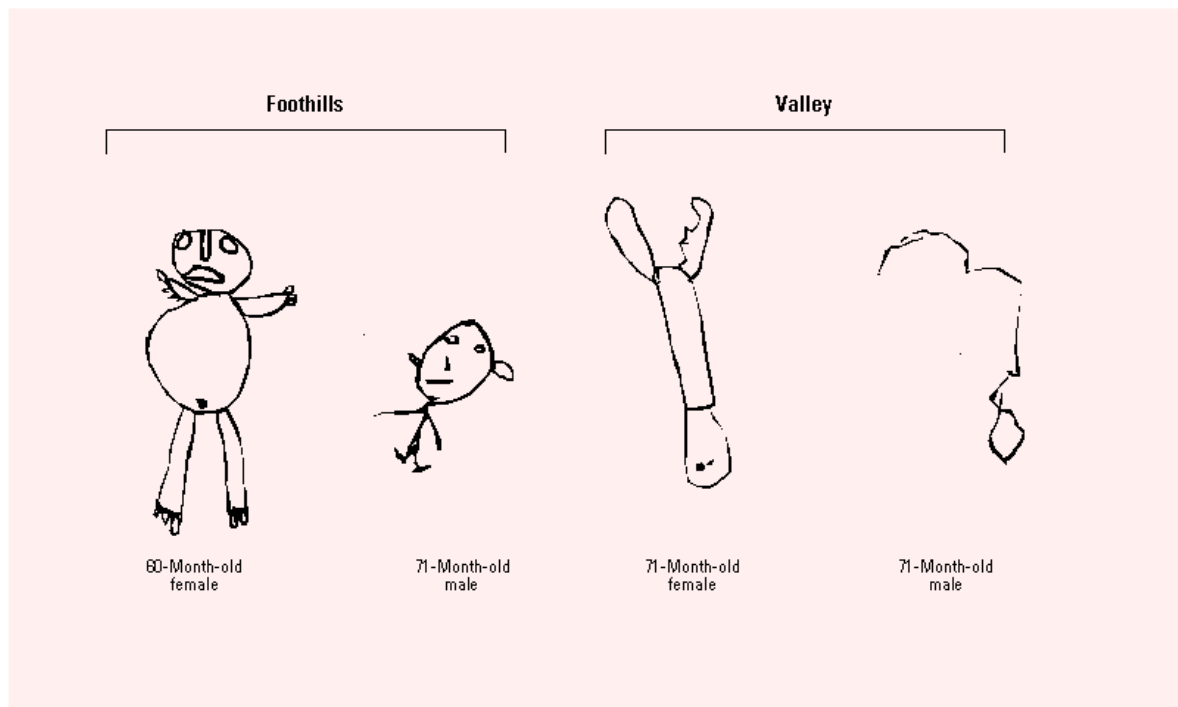
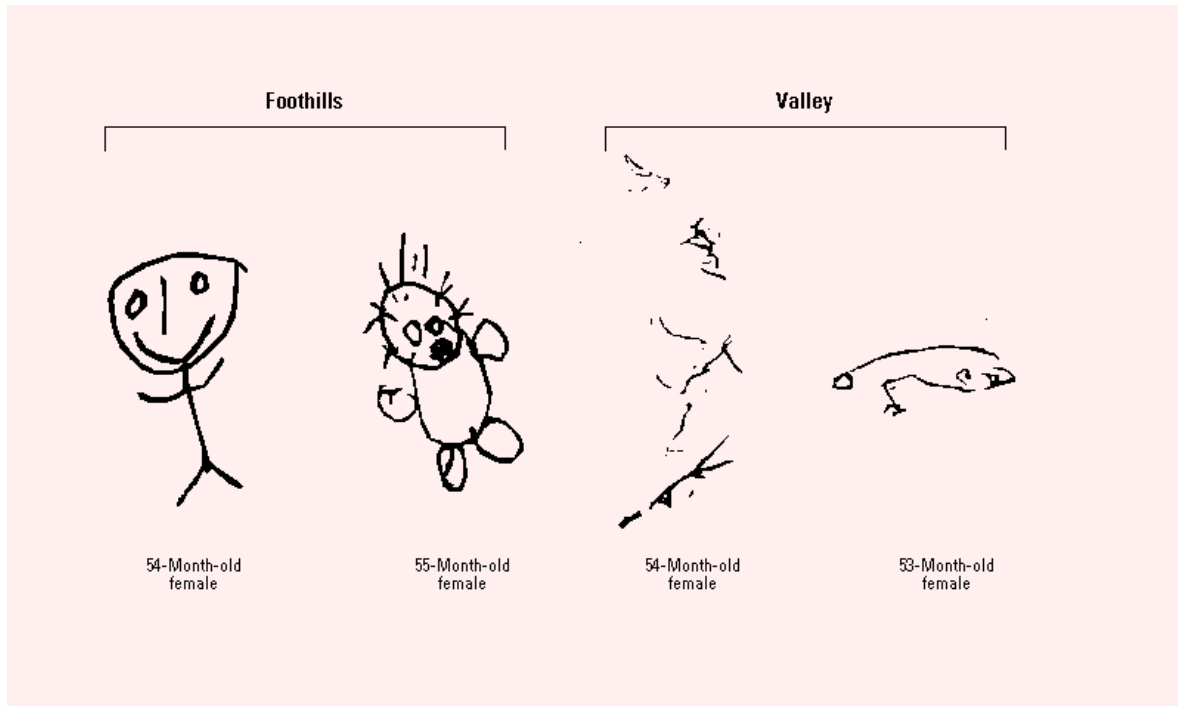


# Poisoned Bodies – Poisoned Minds

*A Submission to  
The Good Childhood Inquiry  
November 2006*

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in association with the Maranatha Community  
and the Council for Health and Wholeness, Manchester**

*...a picture says more than a thousand words.*



Representative drawings of a person by 4-year old (top) and 5-year-old (bottom) Yaqui children of Sonora, Mexico. Children from the valley were frequently exposed to pesticides, whereas the children living on the foothills had little exposure to pesticides. (Guillette EA, et al. An anthropological approach to the evaluation of preschool children exposed to pesticides in Mexico. *Environ Health Perspect.* 1998; 106: 347-53. Reprinted with permission from Environmental Health Perspectives)

## **A. THIS DOCUMENT**

This document has been prepared for *The Good Childhood Inquiry*, The Children's Society.  
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## **B. THE MARANATHA COMMUNITY/COUNCIL FOR HEALTH AND WHOLENESS**

This paper has been prepared by Dr Hans-Christian Raabe who is a member of the Maranatha Community and the Council for Health and Wholeness.

The Maranatha Community is a Christian movement with many thousands of members throughout the country active in all the main churches. The Council for Health and Wholeness is its medical research arm.

The membership of the Maranatha Community includes a substantial number of people involved in work for the community in both professional and voluntary capacities. Since its formation 26 years ago, it has been deeply involved in work a broad range of issues related to children including child abuse prevention and relief work befitting children in many countries.

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The Leader of the Community, which has thousands of members throughout the United Kingdom, is Mr. Dennis Wrigley.

## **C. PREFACE**

This paper is presented with great concern for the sake of our children. We welcome the Inquiry by the Children's Society as a timely initiative to assess the situation of childhood in the UK. In this submission, we would like to focus mainly on the issue of health with special emphasis on the – in our opinion – neglected area of toxicity, nutritional deficiency and child health. We aim to prove that the combination of environmental toxicity and nutritional deficiencies is a major contributing factor in the many serious health and behavioural problems observed in many children today.

This paper is offered in for consideration and discussion and it is recognised that there is a variety of conflicting views on this subject. Every effort has been made to ensure the accuracy of its contents. However, any corrections or observations will be welcome.

We agree to this submission being published and agree to this evidence to being used by The Children's Society. However, we would be grateful for acknowledgement.

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# **Poisoned bodies – poisoned minds**

## **Child health and environmental toxicity**

### **1. Introduction**

Children today grow up in a more toxic environment than at any time in the history of mankind. Toxins – poisonous substances – interfere with brain development; they affect children's behaviour and their ability to learn. Toxins negatively affect the child's immune system, cause lung damage and trigger asthma. Toxins contribute to the increase in childhood cancer. Poisonous substances negatively affect the child whilst in the mother's womb, interfere with brain development and lead to a measurably lower IQ in children even many years later. They cause low birth weight (with all the adverse effects this has on the future health of a child) and birth defects. Finally, environmental poisons have an adverse effect on reproduction, contributing to infertility.

Hundreds of toxic exposures, such as air pollutants, pesticides, toxic metals and many man-made chemicals contribute to these adverse health effects. In addition to these poisonous substances in the environment, food processing has added a large number of chemicals to our food. Today's processed foods contain significant amounts of food additives, such as colourings, preservatives, flavour enhancers, stabilisers, antioxidants and others. For some of these additives, the health effects are known, but for many of them their effects – especially on child development – are totally unknown as are their short and long-term health effects. Food processing also reduces essential nutrients such as trace elements, minerals and some essential fatty acids necessary for healthy brain development.

The combination of environmental toxins, especially toxins adversely affecting brain development, food additives and a reduction in essential nutrients in processed foods is likely to contribute significantly to the dramatic increase in childhood disorders such as attention deficit hyperactivity disorder (ADHD), learning disabilities, behavioural disturbances and autism. All of these conditions have increased, some dramatically, over the past decades.

In addition to these chemical poisons, children are exposed to emotional and spiritual poison in the form of media violence and a dramatic increase in the occult. Media violence – such as the violence shown on TV and violent video games - have a profoundly adverse effect on the behaviour of children, leading to increased aggression, physical violence and can lead to 'copycat behaviour' with fatal consequences. Children today spend an enormous amount of time exposed to the media, far more so than in previous generations. In many instances they spend more time watching TV, playing video games or on the internet than they spend with their parents or their teachers. Therefore, the media have a more profound effect on shaping children's worldview, values and behaviour than their parents or teachers have. The impact of this is very profound and is manifested in many areas, such as social conduct, nutrition, drug and alcohol abuse. In addition, poor diet and lack of physical activity are both linked to the amount of time spent watching TV and both are significant contributors to the epidemic of childhood obesity. The use of drugs and alcohol is often 'normalised' on TV, which is likely to contribute to the very high levels of drug and alcohol abuse among British children and adolescents. The increasingly explicit portrayal of

sex on TV through 'soaps' or 'Big Brother' and in other media is also having a profound impact on the sexual behaviour of adolescents, encouraging early 'casual' sexual experimentation. This has contributed to the current epidemic of sexually transmitted diseases (many only treatable, but not curable) among children and adolescents and the high number of teenage pregnancies.

Another source of poisoned influence on children is the explosion in occult activity. Increasingly, over the past few years, occult activity such as witchcraft is being portrayed as normal on TV. Series such as 'Buffy the Vampire Slayer' and 'Sabrina the Teenage Witch', and the best-selling Harry Potter books and films expose and attract many children to the occult. Through such media exposure, including the internet, a huge interest in the occult has been created. The internet has become an ever-increasing resource for occult material, and children have no difficulty finding advice on subjects such as how to cast a spell, witchcraft, how to make contact with demons/spirits, how to communicate with the dead and other occult activities. While there has been little research into the adverse effects of occult involvement, there is sufficient anecdotal evidence to give cause for serious alarm. The full adverse consequences on this generation of children of the explosion of the occult will not be fully obvious for many years to come.

What is happening today is that we are carrying out a huge unplanned experiment with the health of children, exposing them to hundreds of toxic substances and influences, many of which have not been adequately tested for the adverse effects they have. Children today are growing up in an enormously toxic environment. Today's children breathe polluted air, drink polluted water and eat polluted food. In addition, their minds are being polluted by much of what they see on TV or access on the internet. Many, or most of these poisonous exposures are – at least in principle – preventable. Dr Herbert Needleman, Professor of Paediatrics and Psychiatry stated in his keynote address to the world congress on children and environmental health, Washington, D.C. in 2001: *'We are conducting a vast toxicological experiment in which our children and our children's children are the experimental subjects.'* Once the outcome of this experiment is clear, it will be too late for an entire generation of children.

## 2. The toxic environment.

During the last 50 years hundreds of thousands of chemicals have been developed. The global production of chemicals has increased from 1 million tonnes in 1930 to 400 million tonnes today. Some 100,000 different substances are registered in the EU, 10,000 of which are marketed in volumes of more than 10 tonnes and a further 20,000 at 1-10 tonnes. (WWF, Family Biomonitoring Report, 2004.) In the US, there are 80,000 substances used in commerce. Over 3,000 are in high production, produced in quantities of over one million tonnes per year.

However, for the large majority of these substances, our knowledge of their effects is very limited. Therefore, until there is a better understanding, the **precautionary principle** needs to be applied. The Rio Declaration on Environment and Development from June 1992 states:

*'In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.'* (Principle 15 of the 'Rio Declaration'; www.unep.org)

This precautionary principle is based on the simple fact that we will never have all the information required to assess the full adverse impact a substance has. It calls for the duty to prevent harm in the first place, even when the evidence of possible harm is not there (yet). Protecting children from environmental harm is at the core of sustainable development, to protect future generations. It is also an issue of social justice, to protect those most vulnerable to environmental toxins, children. According to a recent WHO report, almost one third of the global disease burden can be attributed to environmental risk factors. Over 40 per cent of this burden falls on children under five years of age, who account for only 10 per cent of the world's population. A major contributing factor to these diseases is malnutrition, which contributes to children being more susceptible to adverse environmental factors, including infections. Other major environmental problems directly affecting children include high levels of toxic chemicals such as lead and children being at risk of pesticide poisoning because they work in agriculture. (United Nations. Pollution-related diseases kill millions of children a year says new UN report. Press Release; 9th May 2002.)

### **3. Why children are so much more vulnerable to environmental toxins than adults**

#### **1. Children are exposed to greater amounts of toxins.**

Children breathe more air, consume more food, and drink more water than adults, due to their substantial growth and higher metabolism. Therefore, they are exposed to much higher amounts of pollutants and other toxins relative to their weight than adults.

- An infant takes in **twice as much air** per pound of body weight as an adult. Subject to the same air pollution, an infant therefore would inhale proportionally twice as much toxin as an adult. Children also **drink proportionally more water** than adults. Infants and children drink more than 2½ times as much water as adults per body weight. Children between the age of one to five years of age **eat 3 to 4 (or more) times as much food** per pound body weight as an adult. (Agency for Toxic Substances and Disease Registry, US Department of Health and Human Services. Healthy Children – Toxic Environments. Report of the Child Health Workgroup; April 28, 1997.)
- Children may also be exposed to greater amounts of toxins in the environment due to the fact that they **spend significant amounts of time on the floor and ground**. As a result, they are more likely to come into contact with toxins that are found in dust, carpets, and soil, such as lead. Some airborne contaminants, such as radon, mercury, and some pesticide vapours, concentrate in **greater quantities at ground level**, so small children would be exposed to higher concentrations of these toxins than adults in the same room. Pesticide concentrations in the breathing zone of a child are 50 – 250% times higher than the concentrations in an adult breathing zone over a 24-hour period after the pesticide is applied. (Fenske RA et al. Potential exposure and health risks of infants following indoor residential pesticide applications. Am J Public Health. 1990; 80: 689-93.)
- In another study, children and adults who were exposed to the application of a certain pesticide (methyl parathion) in their house had the levels of this pesticide tested. **Children under the age of three had twice the levels of this pesticide** in their bodies compared with children over the age of three and adults. (Rubin C. et al. Assessment of human exposure and human health effects after indoor application of methyl parathion in Lorain County, Ohio, 1995-1996. Environ Health Perspect. 2002; 110 Suppl 6:1047-51.)

- Proportional to body mass, a child's **brain is larger** and receives about double the blood flow per unit of weight compared with an adult's brain. Substances that adversely affect the child's brain (neurotoxins) will have a disproportionate effect on a child's brain when compared with an adult's brain.
- Young children have a natural urge to **place objects in their mouths**. This can cause them to ingest toxins in their environment to which adults would not necessarily be exposed. For example, in homes with high dust-lead levels, children may ingest lead when they put their hands or toys in their mouths. Children also may be exposed to arsenic and creosote, two toxic chemicals used to pressure-treat wood.
- Small children also **more readily absorb the nutrients (and toxins)** they ingest. Although this enhanced ability is of advantage when it comes to nutrients, it can also increase a child's exposure to toxins such as lead. A toddler will absorb about 50% of ingested lead, whereas an adult will absorb about 15%.

## 2. Children's developing bodies are more susceptible to chemicals.

A child needs to develop organs that will last a lifetime. In addition, the development of the child is dramatic. As Ken Olden, Director of the National Institute of Environmental Health Sciences stated, *"A little kid goes from a single cell to a laughing, sociable, intelligent, friendly human being over a course of two years - that's dramatic growth and development."*

Growing organs are more vulnerable to toxins than organs that are fully developed. In addition, the body may not be able to repair damage caused by toxins during the vulnerable phase of development. Damage to organs such as the brain may therefore be irreversible.

- Vulnerability to chemical exposures can be greater during certain periods of development. **Windows of vulnerability** are specific to each developing body system not only in the foetus, but also after birth. For example, the most sensitive period to chemical exposure for the development of the central nervous system of the foetus is different to the development of limbs or the external genitalia. Exposure to low-level lead (as through leaded petrol in the past) adversely affects the development of the brain in utero. Exposure to methylmercury in Minamata, Japan, caused severe brain damage and cerebral palsy among children born to exposed women, but the women did not seem to be adversely affected.
- During the first months and years of life, **children's organs are developing rapidly**, making them more prone to damage through toxins. For example, the nervous system and the brain continue to develop throughout childhood and consequently are especially vulnerable to environmental factors. If a child is exposed to neurotoxins such as lead or mercury, the resulting loss of intelligence or the resultant development of behavioural problems can be irreversible. There appears to be a particularly high vulnerability of the foetus, the embryo and small children up to the age of 3 to the adverse effects of neurotoxicants. (Cooper K, et al. Environmental Threats to Children. Toronto Public Health, 2005.)
- Children may be more susceptible to some toxins because **their liver and kidneys are not fully mature and cannot detoxify** and excrete harmful substances as readily as adults. Infant kidneys do not have the adult capacity to excrete certain toxicants for the first few months of life. The liver of an infant does not have the adult capacity to metabolise and excrete toxicants.

In many animal experiments, the earlier a toxin was administered in the life of an animal, the higher was the risk of adverse outcomes, including the development of cancers. (Miller MD, et al. Differences between children and adults: implications for risk assessment at California EPA. *Int J Toxicol* 2002; 21: 403-18.)

In traditional testing for toxins the timing of exposure is not usually taken into account, and toxicity is determined by levels of exposure rather than timing of exposure. However, the implication of the evidence quoted above is that at certain windows of vulnerability far lower levels of toxins than otherwise thought hazardous can produce significant adverse effects.

### 3. Children have more time to develop diseases.

- Many environmentally related diseases take decades before symptoms develop. Because children have more years to live than adults, they have more time to develop latent diseases. Because of the long latency period of these diseases, exposures in childhood are more likely to result in disease than exposures in adulthood. For example, men who were exposed to pesticides at work were more than five times as likely to develop Parkinson's disease and more than twice as likely to develop Alzheimer's disease later in life. **Early exposure to neurotoxins may give a greater risk of Parkinson's or Alzheimer's disease later in life, and early pesticide exposures may give a greater risk of cancer years later.** (Baldi I, et al. Neurodegenerative diseases and exposure to pesticides in the elderly. *Am J Epidemiol.* 2003; 157: 409-14.)
- Some scientist believe that a large portion of a lifetime risk of cancer from some environmental carcinogens is actually due to **exposures early in life rather than the total exposure** throughout life. (U.S. Environmental Protection Agency. Supplemental Guidance for Assessing Cancer Susceptibility from Early-Life Exposure to Carcinogens. 2003)

### 4. Some children are at greater risk than others

Greater risks from environmental exposures can exist for some children. Risk factors include poverty, poor nutrition, parental occupation and genetic variability.

- **Poverty** is often associated with older, poorly maintained housing with dampness and increasing mould problems, which can lead to respiratory illness and higher lead exposure. Cigarette smoking at home is a significant risk factor for many health problems including impaired cognitive abilities, and it is more common among those living in poverty. (Salo PM et al. Dustborne *Alternaria alternata* antigens in US homes: results from the National Survey of Lead and Allergens in Housing. *J Allergy Clin Immunol.* 2005; 116: 623-9. Yolton K, et al. Exposure to environmental tobacco smoke and cognitive abilities among U.S. children and adolescents. *Environ Health Perspect.* 2005; 113: 98-103.)
- **Poor nutrition** is more common among children growing up in poverty and is a risk factor for greater uptake of contaminants. Some pesticides are thought to have more adverse effects on children who are iron-deficient. A diet low in calcium and iron can result in an increased absorption of lead. (Bruening K, et al. Dietary calcium intakes of urban children at risk of lead poisoning. *Environ Health Perspect.* 1999; 107: 431-5.)
- **Parents who work with toxic substances** can contribute to 'carry-home' exposures that adversely affect their children. Farm workers can bring home pesticides on their skin, clothing and equipment. This has been linked to increasing risk of certain childhood cancers. Some

parents work with substances such as organic solvents. These are used in many different occupations, including laboratory technicians, domestic cleaners, etc. These substances can affect germ cells or the developing foetus. In animal studies, organic solvents have been associated with spontaneous abortions and birth defects. Parental exposure is associated with a wide range of adverse impacts on the nervous system including impaired visual, cognitive and motor functions, language and behaviour of their children.

- **Genetic variability** leads to some children being more vulnerable to certain environmental toxins than others. In one study, a higher risk of leukaemia existed for children that had a certain genetic change in the liver enzyme system (cytochrome P-450) responsible for 'deactivating' carcinogens (cancer-causing substances). In this study, children with leukaemia had also been found to be exposed to certain insecticides while in the womb. Indoor use of some insecticides and pesticide use in the garden and on indoor plants, in particular frequent prenatal use, were associated with increased risks of developing acute lymphoblastic leukemia (ALL) in children. (Infante-Rivard C et al. Risk of childhood leukemia associated with exposure to pesticides and with gene polymorphisms. *Epidemiology*. 1999; 10:481-7.) Children with a certain genetic abnormality in the enzyme paraoxonase that detoxifies organochlorine pesticides may be at increased risk of brain tumours. (Furlong CE et al. Role of paraoxonase (PON1) status in pesticide sensitivity: genetic and temporal determinants. *Neurotoxicology*. 2005; 26: 651-9.) When the pesticide chlorpyrifos was found in the blood of pregnant women above the limit of detection coupled with low maternal paraoxonase activity (ie, reduced ability to detoxify this pesticide), this was associated with a significant but small reduction in head circumference. A reduced head circumference is associated with reduced cognitive abilities including a lower IQ and poorer school performance. (Berkowitz GS, et al In utero pesticide exposure, maternal paraoxonase activity, and head circumference. *Environ Health Perspect*. 2004; 112: 388-91.)

## 5. Biomonitoring – measuring chemicals in our bodies

We all carry chemicals from industry or agriculture in our bodies. Biomonitoring refers to the direct measurement of these chemicals in the body. The US and Germany have national biomonitoring programmes for children and adults.

- **US data** show that the average adult carried over 91 pesticides and toxic chemicals in their bodies. Of those tested, 100% had pesticide residues in their bodies and 93% had detectable levels of chlorpyrifos, a widely used organophosphate pesticide found to be neurotoxic in animal studies. Phthalates, chemicals found in many cosmetics such as nail polish, shampoos and soft plastic toys, were present in most people. Polychlorinated biphenyls (PCBs) are still commonly found in human tissue, even though their production was discontinued in the 1970s. Six per cent of women of child-bearing age had mercury levels at or above the level of concern for foetal development. ([www.cdc.gov/exposurereport](http://www.cdc.gov/exposurereport))
- In a recent US study, meconium of newborn babies was examined for the presence of various environmental toxins. Eighty-four per cent of newborn babies already had detectable mercury levels at birth, 27% had detectable levels of lead, and 8.5% had detectable cadmium levels. Over one-quarter of the newborn babies had DDT, over half had malathion and nearly three-quarters already had lindane in the meconium. (Enrique MO, et al. Prevalence of fetal exposure to environmental toxins as determined by meconium analysis. *Neurotoxicology*. 2002; 23: 329-39.)

- A recent biomonitoring report by the WWF found the following pollutants and percentage of children affected among 14 **UK children**: BDE 153 (penta and octa; flame retardants) 100%; p,p' DDE 100%; different PCB congeners 100%; hexachlorobenzene 79%; DEHP 79%; HCH 36%; perfluorooctanoic acid (PFOA) 36%; BDE 209 (deca) 29%; perfluorooctane sulphonate 14%. (WWF, Family Biomonitoring Report, 2004)

## 6. Evidence of environmental childhood diseases

There are a number of conditions among children that have increased significantly over recent decades. All of these are caused by multiple factors but it is likely that environmental toxins play a role in all of these. It is a slow process to prove that environmental toxins play a significant role in these serious conditions. Environmental control is therefore often delayed or even opposed by the industry until there is definite proof of harm, which may take decades.

### 1. Brain development, learning disabilities, ADHD, dyslexia, behavioural disorders and autism.

A child only gets one chance to develop his or her brain. The effects of environmental toxins on the brain are therefore particularly severe. Substances that harm the brain are called neurotoxic. Environmental exposure to toxic substances are known or suspected to contribute to the following conditions: (Cooper K, et al. Environmental Threats to Children. Toronto Public Health, 2005)

- Intellectual deficits, manifested as lower IQ and poor school performance.
- Deficit in speech or language.
- Deficits in reading, spelling and mathematics scores.
- Poorer handwriting and poorer hand-eye coordination.
- Deficit in motor function, deficits in reaction time.
- Reduced attention span.
- Autism spectrum disorder.
- Attention deficit hyperactivity disorder (ADHD).
- Increased risk of learning disabilities.
- Increased risk of failure to complete high school.
- Behavioural problems such as aggressive behaviour and/or propensity to violence.
- Visual or hearing deficits.

There is a substantial overlap between conditions such as dyslexia, dyspraxia, attention-deficit / hyperactivity disorder (ADHD) and autistic spectrum disorders (ASD). Dyslexia refers to specific difficulties in the acquisition of written language skills. Dyspraxia describes uncoordination ('clumsiness'). ADHD involves hyperactive and impulsive behaviours, attention difficulties, or both. In autistic spectrum disorders, the central features are specific difficulties in social interaction and communication and a restricted range of behaviours. Between them these developmental conditions affect more than 10% of the school-age population.

It is important to recognise that multiple risk factors including genetic and nutritional factors contribute to these conditions. In view of the recent increase of these conditions, it has to be noted that today's children have not suddenly 'sprouted' autism or ADHD genes. The role of the

environment, including environmental toxins in these conditions is perhaps not widely recognised. For example, low-level prenatal PCB exposure or lead exposure in early life can lead to permanently impaired brain development.

A report by the Greater Boston Physicians for Social Responsibility (*In Harm's Way: Toxic threats to child development*, May 2000) examines the contribution of toxic chemicals to neurodevelopmental, learning, and behavioural disabilities in American children. In the US, an epidemic of developmental, learning, and behavioural disabilities has become evident among children. While this report focuses on the US, we are convinced that the same observations and conclusions apply to the UK, where there has been an increase in autism, ADHD and behavioural problems in children.

It is estimated that nearly 12 million children (17% of all children) in the United States under the age 18 suffer from one or more learning, developmental, or behavioural disabilities.

- Attention deficit hyperactivity disorder (ADHD), according to conservative estimates, affects 3 to 6% of US school children, though recent evidence suggests the prevalence may be as high as 17%. The number of children taking the drug Ritalin for this disorder has roughly doubled every 4-7 years since 1971 to reach its current estimate of about 1.5 million.
- Learning disabilities alone may affect approximately 5-10% of children in schools. The number of children in special education programs classified with learning disabilities increased 191% from 1977 to 1994 in the US.
- The incidence of autism may be as high as 2 per 1000 US children. One study of autism prevalence between 1966 and 1997 showed a doubling of rates over that time frame. Within the state of California, the number of children entered into the autism registry increased by 210% between 1987 and 1998. These trends may reflect true increases, improved detection, reporting or record keeping, or some combination of these factors. Whether new or newly recognized, these statistics suggest a problem of epidemic proportion.
- In the UK, it has been estimated that there may have been a tenfold increase in autism over the past decade, according to the Autism Research Unit, which is part of the University of Sunderland. (BBC News, 27 February, 2001)

A variety of chemicals commonly encountered in industry and the home can contribute to developmental, learning, and behavioural disabilities. Neurotoxins that appear to have 'trivial' effects on an individual have profound impacts when applied across populations. For example, a loss of 5 points in IQ is of minimal significance in a person with an average IQ. However a shift of 5 IQ points in the average IQ of the US population of 260 million increases the number of functionally disabled by over 50% (from 6 to 9.4 million), and decreases the number of gifted by over 50% (from 6 to 2.6 million).

Developmental neurotoxins are chemicals that are toxic to the developing brain. They include the metals lead, mercury, cadmium, and manganese, nicotine, pesticides such as organophosphates and others, widely used in homes and schools, dioxin and PCBs that accumulate in the food chain, and solvents, including ethanol and others used in paints, glues and cleaning solutions. Solid evidence of neurotoxicity demonstrating these associations exist at this time for only a small number of substances. These include the metals lead and mercury, nicotine in the form of maternal smoking, dioxins and some pesticides, solvents and PCBs.

Vast quantities of neurotoxic chemicals are released into the environment each year.

- Of the top 20 chemicals reported by the Toxics Release Inventory released in the largest quantities into the environment in the US in 1997, nearly three-quarters are known or suspected neurotoxicants. They include methanol, ammonia, manganese compounds, toluene, phosphoric acid, xylene, n-hexane, chlorine, methyl ethyl ketone, carbon disulfide, dichloromethane, styrene, lead compounds, and glycol ethers. Over a billion pounds (454,000 tonnes) of these neurotoxic chemicals were released directly on-site by large, industrial facilities into the air, water, and land.
- Vast quantities of neurotoxic chemicals are also used in industrial processes and incorporated into products. For example, over half of the top twenty chemicals in use (over 500 million pounds, 227,000 tonnes), and half of those incorporated into products in Massachusetts, are known or suspected neurotoxins.

There follows a discussion of the main known neurotoxins:

**a) Lead.** Exposure to lead during infancy and childhood is associated with attention deficit, increased impulsiveness, reduced school performance, aggression, and delinquent behaviour. Effects on learning are seen at blood lead levels below those currently considered “safe.” Low-level lead exposure in utero is also linked to greater risk of prematurity, low birth weight and adverse effects on the senses, such as reduced hearing acuity. Often, blood lead levels of below 10 micrograms/dl are considered to be ‘safe’, however there is increasing evidence, that there is no ‘safe’ blood lead level. (Barbosa F Jr et al A critical review of biomarkers used for monitoring human exposure to lead: advantages, limitations, and future needs. Environ Health Perspect. 2005; 113: 1669-74.)

- The use of lead in manufacturing increased by 77% in Massachusetts between 1990-1997.
- One million children in the US exceed the currently accepted threshold for blood lead level exposure that affects behaviour and cognition (10 micrograms/dl). Reducing the toxic threshold in keeping with the results of the most recent studies would further lower this threshold, resulting in the addition of millions of children to the ranks of those recognised as impaired by lead exposure.
- In a recent US study, children’s blood lead levels and their IQ were measured. On average, their IQ declined by 7.4 points as lifetime average blood lead concentrations increased from 1 to 10 micrograms/dl. Blood lead concentrations, even those below 10 micrograms/dl, were inversely associated with children's IQ scores at three and five years of age. The authors conclude: *‘These findings suggest that more U.S. children may be adversely affected by environmental lead than previously estimated.’* (Canfield RL et al. Intellectual Impairment in Children with Blood Lead Concentrations below 10 µg per Deciliter. NEJM, 2003; 348: 1517-26.)
- In a recent UK study, children with behavioural and/or developmental problems had on average significantly higher lead concentrations than normal children. The proportion of children with lead concentrations above those commonly defined as ‘toxic’, 10 micrograms/dl, were found in 12% of children with behavioural and/or developmental problems but in hardly any of the controls (0.7%) (Lewendon G. et al. Should children with developmental and behavioural problems be routinely screened for lead? Arch Dis Child 2001; 85: 286-288.)

**b) Mercury.** Large foetal exposures to methylmercury, an organic mercury compound, cause mental retardation, abnormal gait and visual disturbances including blindness. Smaller foetal exposures, such as those resulting from regular maternal fish consumption, have been implicated in language, attention, and memory impairments that appear to be permanent. Children seem most at risk in the womb, where mercury seems to deform the brain's fragile architecture and interferes with the maturation and migration of brain cells.

- Children born to mothers in the Danish Faroe Islands in the North Atlantic were examined at age 7 and 14. Prior to this, levels of mercury in the pregnant mothers were measured. The mothers of the Faroe Islands had eaten pilot whale meat, which had high levels of mercury. At age seven, the more mercury the children had been exposed to in the womb, the worse they were off in terms of language skills, attention span and motor development. At age 14, the children had not recovered nor compensated for the damage. (Children's health and the environment in the Faroes; [www.chef-project.dk](http://www.chef-project.dk))
- About 1.16 million women in the U.S. of childbearing years eat sufficient amounts of mercury-contaminated fish to risk damaging brain development of their children.
- Mercury contamination of US waterways is so widespread that 40 states have issued one or more health advisories warning pregnant women or women of reproductive age to avoid or limit fish consumption. Ten states have issued advisories for every lake and river within the state's borders.
- The UK Food Standards Agency (FSA) warned pregnant women two years ago to limit their consumption of tuna to two cans a week to protect their unborn children. There are now concerns — echoing health fears in America — that children should be prevented from eating too much tuna because it is more contaminated with mercury than most fish. Concerns have been raised following the case of an American child who developed learning difficulties after eating a portion of tuna a day. A 10-year-old boy had consumed a portion a day of white albacore tuna. Although he had previously seemed bright and motivated, he started to have learning difficulties. Doctors who conducted blood tests concluded the child was suffering from mercury poisoning. In Britain the FSA advised children not to eat shark, marlin and swordfish. Tuna has, however, been exempted from restrictions because tests showed it had lower mercury levels. (Sunday Times, 07 August 2005.)
- There has been the debate on whether Thimerosal (Thiomersal), a mercury-based preservative in children's vaccines, may be responsible for the exponential growth of autism, attention deficit disorder, speech delays, and other childhood neurological disorders. Prior to 1989, US infants generally received three vaccinations (polio, measles-mumps-rubella, and diphtheria-tetanus-pertussis). In the early 1990s, public health officials increased the number of Thimerosal-containing vaccinations. In a 1991 memo, Dr. Maurice Hilleman, one of the fathers of Merck's vaccination programs, warned that 6-month-old children administered the vaccines on schedule would suffer mercury exposures 87 times the government safety standards. He recommended that Thimerosal be discontinued. In 2000, the CDC met with pharmaceutical companies and the FDA in secret to review its findings linking Thimerosal with the dramatic rise in neurological illnesses. According to transcripts, participants were alarmed about the undeniable links between the Thimerosal and widespread brain damage in children. Dr. Bill Weil told the group, "You can play with [the results] all you want. They are statistically significant." Dr. Richard Johnston admitted he feared his grandchild getting a Thimerosal-containing vaccine. But the group was most concerned with keeping the findings secret. The CDC now says it has "lost" the data that supported the crucial study and has

persistently defied congressional requests and federal law requiring it to open up the federal Vaccine Safety Database to scientists and the public. Autistic children have been shown to have higher mercury loads than nonautistics, and there have been reports of significant improvements in some brain-injured children by removing mercury from their brains. Most of the symptoms of autism are similar to the symptoms of mercury poisoning. Scientists have been able to induce autism-like symptoms in mice by exposing them to Thimerosal. A recent study by an FDA scientist, Dr. Jill James, found that many autistic children are genetically deficient in their capacity to produce glutathione, an antioxidant generated in the brain that helps remove mercury from the body. Drug makers wary of liability reduced Thimerosal in most children's vaccines in recent years, but the preservative remains in flu vaccines, tetanus boosters, and over-the-counter drugs. (Autism, mercury, and politics; Boston Globe, 1st July 2005)

**c) Nicotine.** Children born to women who smoke during pregnancy are at risk of IQ deficits, learning disorders, and attention deficits. Children born to women who are passively exposed to cigarette smoke are also at risk of impaired speech, language skills, and intelligence. In a large US study, a significant negative association between exposure to cigarette smoke and cognitive deficits among children was found even at extremely low levels of exposure. This relationship was still significant after adjusting for other factors, including sex, race, region, poverty, parent education and marital status, ferritin, and blood lead concentration. (Yolton K, et al. Exposure to environmental tobacco smoke and cognitive abilities among U.S. children and adolescents. *Environ Health Perspect.* 2005; 113: 98-103.)

**d) Dioxins and PCBs.** PCBs include a group of over 200 compounds used for many different purposes until they were restricted in the early 1970s. However, PCBs are extremely stable even at high temperatures, resistant to biodegradation and highly soluble in lipids (fats). For this reason, they are highly persistent in the environment. They are highly toxic to the developing nervous system.

- In studies examining children born to mothers from Michigan, US, who regularly ate PCB-contaminated fish during pregnancy a large number of adverse outcomes were noted. These include abnormal reflexes in newborn babies, reduced motor skills among infants, cognitive deficits at age 4 and IQ deficits at age 11. (Cooper K, et al. *Environmental Threats to Children.* Toronto Public Health, 2005.)
- Monkeys exposed to dioxin as foetuses in similar concentrations to human breast milk showed evidence of persistent learning disabilities. One German study indicated that children exposed to PCBs after birth may have learning and motor developmental deficits, however, this is not found in all studies. (Rice DC. Effect of postnatal exposure to a PCB mixture in monkeys on multiple fixed interval-fixed ratio performance *Neurotoxicology & Teratology.* 1997; 19: 429-34. Walkowiak J, et al. Environmental exposure to polychlorinated biphenyls and quality of the home environment: effects on psychodevelopment in early childhood. *Lancet.* 2001; 358: 1602-7.)

**e) Pesticides.** Pesticides include a wide range of different substances with many different 'pest-killing' purposes and actions. As all these substances are aimed at killing animals or plants, it is not surprising to find that they have adverse effects on humans. There are concerns about neurotoxicity (interfering with the normal function of the brain), and about pesticides causing cancer, birth defects and interfering with the immune and endocrine systems. Children are exposed to pesticides from use in homes, schools, other buildings, lawns and gardens, through food and contaminated drinking water, from agricultural application drift, overspray or off-gassing, and

from carry-home exposure of parents occupationally exposed to pesticides. Parental exposure during the child's gestation or even preconception may also be important.

- The World Health Organisation reports that there are over 1,000 pesticides, in over 100,000 commercial formulations, being used worldwide. In the UK in 2003, sales of 'plant protection products' including pesticides were worth £426 million, representing 28,400 tonnes of active ingredient. (Online data [www.pesticides.gov.uk](http://www.pesticides.gov.uk).) Commercial chemical fertiliser production went up from around 2 million tons in 1950 to about 50 million tons in the 1980s. UK production of synthetic pesticides increased by over 700 per cent from 1948 to 1982. By 1988, pesticides were applied to 97 per cent of all arable crops, involving 22.4 tons of active ingredients. (Watterson A. pesticides and your food, 1991. quoted in: Martin Walker. Home Sickness. The Ecologist vol 31 May 2001.p 40-43.)
- The EU directive 91/414/EEC requires review of pesticides already on the market to ensure that they meet modern standards of safety and efficacy. As a result of this directive, approximately 70 active substances out of the 350 (20%) that had UK approvals have been taken off the market. (Online data [www.pesticides.gov.uk](http://www.pesticides.gov.uk).)
- When pesticides are banned in the West, they frequently are still being used in the Third World due to less stringent regulations. Around 30% of the annual \$900 million-per-year pesticides market in developing countries does not meet internationally accepted safety standards. Imported foods may therefore contain pesticides that are banned in the UK. Paradoxically, pesticides that are banned in the UK are not tested for at all. In the US, where testing is far more rigorous, high residues of pesticides have been found in imported foods. (Pesticide News report, quoted in The Ecologist vol 31 May 2001. p. 10.)
- In Britain in the 1980s, Peter Snell, a food technologist, looked at 426 pesticides cleared in Britain by the regulatory authorities and found that 68 were possible carcinogens, 61 were possible mutagens, 35 had been linked with reproductive effects and a further 93 were known irritants. (Watterson A. et al. Pesticides and residues: the case for real control 1986. quoted in: Martin Walker. Home Sickness. The Ecologist vol 31 May2001.p 40-43.)
- Some pyrethroids, a commonly used class of pesticides, causes permanent hyperactivity in animals exposed to small doses on a single critical day of development. Animal tests of pesticides belonging to the commonly used organophosphate class of chemicals show that small single doses on a critical day of brain development can cause hyperactivity and permanent changes in neurotransmitter receptor levels in the brain.
- Children exposed to a variety of pesticides in an agricultural community in Mexico show impaired stamina, coordination, memory, and capacity to represent familiar subjects in drawings. (Guillette EA, et al. An anthropological approach to the evaluation of preschool children exposed to pesticides in Mexico. Environ Health Perspect. 1998; 106: 347-53.)
- 'Normal' levels of organochloride pesticides, as found in populations of pregnant mothers living in New York City, were associated with reduced birth weight and birth length. (Perera FP et al. Effects of transplacental exposure to environmental pollutants on birth outcomes in a multiethnic population. Environ Health Perspect. 2003; 111: 201-5.)
- A metabolite of the pesticide chlorpyrifos is present in the urine of over 80% of adults and 90% of children from representative population samples.

**f) Solvents.** Exposure to organic solvents during development may cause a spectrum of disorders including structural birth defects, hyperactivity, attention deficits, reduced IQ, learning and memory deficiencies.

## 2. Cancer

Childhood cancer is still comparatively rare, even though there has been a significant increase over the past decades. The most common childhood cancers are leukaemia, cancer of the brain and nervous system, and lymphoma.

- In a European study looking at 30 years of data from 35 European countries, there was a one per cent per year increase in childhood cancers. However, even greater increases in cancer rates have been observed in young adults aged 20-44.
- In Canada since the 1970s, there have been significant increases for thyroid cancer in men (annual increase 4.2% per year) and women (annual increase 6.6% per year). Non-Hodgkins lymphoma has increased around 4% per year and lung and brain cancers among women around 2% per year. Testicular cancer has increased by 1.7% per year.
- Childhood malignancies linked to pesticides in case reports or case-control studies include leukaemia, neuroblastoma, Wilms' tumour, soft-tissue sarcoma, Ewing's sarcoma, non-Hodgkin's lymphoma, and cancers of the brain, colorectum, and testes. In a German study of children of professional pest controllers, a 2.6-fold increased risk of developing leukaemias or lymphomas was observed. Children may be particularly sensitive to the carcinogenic effects of pesticides. There is potential to prevent at least some childhood cancer by reducing or eliminating pesticide exposure. (Zahm SH, Ward MH. Pesticides and childhood cancer. *Environ Health Perspect* 1998;106 Suppl 3: 893-908. Meinert R et al. Leukemia and non-Hodgkin's lymphoma in childhood and exposure to pesticides: results of a register-based case-control study in Germany. *Am J Epidemiol* 2000; 151: 639-46. Buckley JD. et al. Pesticide exposures in children with non-Hodgkin lymphoma. *Cancer* 2000; 89: 2315-21.)

Since cancers develop after a long latency period of many years or even decades, early childhood or even prenatal toxic influences could contribute to the increase in cancer rates among young adults. Early life exposure to ionising radiation, such as X-rays, doubles the lifetime cancer risk compared to that of an adult exposed to similar levels of radiation.

For a list of substances associated with childhood cancer please see the website of Scorecard [www.scorecard.org](http://www.scorecard.org).

## Suspected risk factors associated with childhood cancer

Type of cancer	Known risk factor	Some suspected environmental risk factors
Leukaemia	Ionising radiation	Maternal alcohol or drug use, maternal diet, maternal exposure to solvents/metalworking, paternal exposure to exhaust fumes, petroleum products or solvents, childhood exposure to pesticides or herbicides.
Non-Hodgkin's lymphoma	Eppstein Barr virus, ionising radiation, immunosuppressants	Nitrate in drinking water, herbicides; HIV infection, malaria and others.
Neuroblastoma (malignant brain tumour)		Exposure to drug phenytoin, maternal exposures to alcohol and tobacco, hair dye, paternal employment in electronics, paternal exposure to hydrocarbons, rubber, ionising radiation, electromagnetic fields and others.
Central nervous system cancer	Ionising radiation	Environmental chemicals such as PAHs, pesticides, nitrosamines, lack of prenatal vitamins, maternal consumption of cured meat/sugar substitutes, paternal employment in aircraft, agriculture, electronics or petroleum industries and others.
Osteosarcoma (Malignant bone tumour)	Chemotherapy, ionising radiation	Parental exposure to chicken farms, fertilisers, herbicides or pesticides and others.
Thyroid cancer	Iodine deficiency, ionising radiation, immune suppression, genetic predisposition	Chlorophenoxy herbicides
Wilms Tumour	Genetic predisposition	Ionising radiation, maternal employment in various occupations, maternal smoking, maternal use of hair dye, parental exposure to pesticides, paternal exposure to hydrocarbons and lead.

(Source: Canadian Partnership for Children's Health and Environment: Child health and the environment – a primer; Toronto, 2005; p. 41f.)

### 3. Asthma

Indoor and outdoor pollution contributes to childhood asthma. Pollution increases the number of cases of asthma, worsens asthma in those who already have it, worsens lung function and increases susceptibility to respiratory infections. Asthma is one of the leading causes of children requiring hospital admission, and a leading cause of absence from school due to sickness. There has been a dramatic increase in asthma over the past decades:

- Asthma is now 3 to 4 times as common in adults and 6 times higher in children than it was 25 years ago. The number of people in the UK who are currently being treated for asthma has grown to 5.1 million - 1 in 8 children and 1 in 13 adults.
- There are nearly 74,000 emergency hospital admissions for asthma each year - approximately 40,000 adult admissions and 30,000 childhood admissions.
- Treatment for asthma costs the NHS an estimated £850 million a year, but that is only a proportion of the total cost of asthma to society. (National Asthma campaign. Asthma Audit 2001. Background on Asthma, updated July 2002.)

However, it is not just pollution that is associated with asthma. Asthma could be considered as a 'lifestyle disease' associated with the 'westernised lifestyle', similar to obesity, diabetes and hypertension, which are all diseases that accompany the westernised way of living. Unfortunately, the conventional treatment of most of the chronic medical conditions does not take dietary and lifestyle aspects sufficiently into account. There appears to be too much emphasis on the pharmacological treatment of these conditions using drug therapies. This is also the case with asthma. This raises the suspicion that there are strong financial interests in research aimed at the treatment rather than the prevention of asthma and most other chronic diseases. Obviously it is far more lucrative for the pharmaceutical industry to treat a chronic and frequently lifelong condition with medication than it is to prevent its onset or find a cure in the first place.

There are many possible causes for the asthma epidemic including change in diet, less ventilation, more heating and more carpets in houses (encouraging growth in moulds and house dust mites), more time spent indoors, soft toys, maternal or parental cigarette smoking, increasing prevalence of obesity, lead toxicity, changing pattern of childhood illnesses, early introduction of solids and reduced rate of breastfeeding, antibiotic prescribing in early childhood, frequent (*ie*, daily or weekly) paracetamol use and others. Examples of evidence linking nutritional and lifestyle factors but also environmental factors with the increased incidence of asthma are the following (Brostoff, J and Gamlin, L. Asthma, the complete guide. London 1999; p79 ff.):

1. Among Black South Africans moving to Cape Town the rates of asthma in the next generation are 20 times higher than in the rural villages, where the people originated.
2. Chinese people in Taiwan who have stayed in the same place but gradually adopted a westernised lifestyle now have eight times more cases of childhood asthma than they had in 1974.
3. Children in West Germany – despite breathing cleaner air - had far more allergies and asthma than children living in areas in East Germany with heavy air pollution.
4. Children aged 6-7 who eat kiwi or citrus fruit rich in Vitamin C five to seven times per week compared with those who eat fruit less than once per week have a significantly reduced risk of wheeze, cough and shortness of breath (Forastiere F et al. Consumption of fresh fruit rich in Vitamin C and wheezing symptoms in children. *Thorax* 2000; 55: 283-8.)
5. In a group of schoolchildren followed up since 1964 the risk of bronchial hyperreactivity (a marker of how susceptible a person is to asthma) was increased sevenfold among those with the lowest intake of Vitamin C, while the lowest intake of saturated fats gave a tenfold protection. The risk of adult-onset wheezy illness is increased fivefold by the lowest intake of Vitamin E and doubled by the lowest intake of Vitamin C. (Seaton A and Devereux G. Diet, infection and wheezy illness: lessons from adults. *Pediatric Allergy and Immunology* 2000; 11: (Suppl). 1337-40.)

6. Lower dietary intake of Zinc and Magnesium has been found to increase the risk of asthma in a Scottish study. The lowest intake of Vitamin C and Manganese were associated with more than fivefold increased risk of bronchial reactivity. The observed reduction in antioxidant intake in the British diet over the last 25 years is considered to be a likely factor in the increase in asthma over this period (Soutar A et al. Bronchial reactivity and dietary antioxidants. *Thorax* 1997; 52: 166-70.)

Even though some studies do not find an association between diet and asthma, overall there is quite a lot of evidence linking diet and asthma prevention (Fogarty A and Britton J. The role of diet in the aetiology of asthma. *Clinical and Experimental Allergy* 2000; 30: 615-27. Smit HA. Chronic obstructive pulmonary disease, asthma and protective effects of food intake: from hypothesis to evidence? *Respiratory Research* 2001; 2: 261-4.)

Dietary awareness, together with environmental interventions should reduce the development of asthmatic symptoms and should prove a cost effective approach to asthma management in addition to current pharmacotherapy. It is estimated, that with interventions based on current knowledge, a 50% reduction in the prevalence of asthma in the next generation of children could be achieved. (Greene LS. Asthma and oxidant stress: nutritional, environmental and genetic risk factors. *Journal of the American College of Nutrition*. 1995; 14: 317-24. Peat JK. Prevention of asthma. *European Respiratory Journal* 1996; 9: 1545-55.)

#### **4. Human reproduction**

Human reproduction can be seen as a circle of developmental stages, through which humans pass: being in utero, infancy, childhood, adolescence and – for many – becoming a parent. Reproductive disorders can result from chemical exposures they experienced at any of these stages. For example, lead and pesticides have been found in follicular fluid surrounding the female egg and male semen.

- Reproductive toxins interfere with sexual functioning or reproductive ability, and can cause loss of the foetus during pregnancy. In females, they can bring about changes in the onset of puberty and menstrual cycle, decrease fertility, decrease lactation and lead to a premature menopause.
- Lead exposure can cause menstrual disorders and infertility and carbon disulfide, mercury and PCBs can cause an irregular menstrual cycle.
- In males, exposure to phthalates, PCBs and organochlorine pesticides can reduce sperm quality. Lead reduces male fertility and many other substances such as certain pesticides can disrupt male reproductive health.

## 5. Developmental toxins

Developmental toxins are substances that adversely affect the developing embryo, foetus or child. Effects can include ‘spontaneous’ abortion, stillbirth, low birth-weight, decreased head circumference, preterm delivery, visual and hearing defects, cerebral palsy, chromosomal abnormalities, mental retardation, behavioural disturbances.

Known human developmental toxins are mercury, lead, ionising radiation, and PCBs contaminated by dioxins and furans. Organic solvents, pesticides and some air pollutants are suspected as developmental toxicants. For a list of developmental toxicants please see the website of Scorecard at [www.scorecard.org](http://www.scorecard.org).

Prenatal exposure to organic solvents is associated with foetal death and birth defects in animals. In humans, similar effects have been found in some women. Some pesticides adversely affect human development. Both maternal and paternal pesticide exposure has been linked to increased rates of birth defects. Prenatal exposure to some of the organophosphate pesticides has been associated with reduced head circumference at birth (a predictor of reduced cognitive ability) and reduced birth-weight. For pregnant mothers, exposure to air pollution can lead to increased risk of low birth weight, preterm births, and heart defects in babies.

## 6. Endocrine system

The endocrine system includes the body’s hormone-producing glands such as the adrenal glands, the female ovaries and male testicles, the thyroid gland and others. Hormones play a wide spectrum of roles in the body. Thyroid hormones influence all the major body systems including metabolism, heart rate, body temperature and many others. The thyroid gland is absolutely essential for a normal foetal brain development. Many chemicals in the environment interfere with hormone function, by blocking hormones or ‘mimicking’ hormones, thereby increasing hormonal effects. Endocrine disruption therefore has the potential to interfere with many essential body functions including adversely affecting brain development, trigger the development of certain hormone-related cancers and adversely affect the immune system.

Possible effects of environmental endocrine disruptors include:

- ‘Spontaneous’ abortion, changes in the sex ratio of offspring, with fewer male births.
- Male birth defects such as undescended testes, and hypospadias (defects in male genital tract).
- Decreased sperm count or sperm quality.
- Adult testicular cancer (undescended testes is a risk factor).
- Early puberty.
- Polycystic ovary syndrome (PCO).
- Cancer promotion at endocrine sites such as breast cancer, endometrial cancer and cancer of the testes, prostate and thyroid by substances with oestrogenic activity, ‘mimicking’ the female sex hormones.

The number of boys with undescended testes and hypospadias is increasing in industrialised countries, as is testicular cancer among men. Phthalates and PCBs seem to adversely affect sperm

quality. There are reports from many industrialised countries about a decrease in sperm quality and sperm counts.

Substances known to be toxic and acting as endocrine disruptors include:

- PCBs – although production was discontinued in the 1970s, PCBs are persistent and still present in the environment.
- Dioxins and furans (by-products of combustion and some industrial processes).
- Organochlorine pesticides, many of which are banned in developed countries but are still in global circulation due to their persistence, particularly DDT. Foods imported from ‘third world’ countries where DDT is still being used can contain significant levels of DDT.
- Phthalates found in many plastics.
- Bisphenol A, used in polymers, resins, dyes, flame retardants and dental sealants.
- Some pesticides such as the fungicide vinclozolin, iprodione and procymidone.
- Brominated flame retardants, including PBDEs, pentabromophenol and tetrabromobisphenol A, found in many consumer goods such as foam, fabrics, casings for computers and many other electronic appliances.
- Organotin compounds, used as pesticides.

Another source of endocrine disruptors include oestrogens from medications such as the contraceptive pill or hormone replacement therapy (HRT), being excreted into the urine and then entering the water supply. For a complete list of proven or suspected endocrine disruptors please see the website of Scorecard.

## **7. Immune System**

The immune system is the major system enabling the body to protect itself from infections and foreign material. Disruption of the immune system occurs where the immune system is suppressed or when it overreacts, such as in allergies. Many environmental chemicals may have an adverse effect on the immune system. For example PCBs and dioxins can suppress the immune system, as do organochlorine pesticides.

## **7. Children’s exposure to environmental toxins**

### **1. In the womb**

In the womb, the blood vessels of the placenta carry the oxygen, water and nutrients to the developing embryo and foetus. The placenta cannot always block or detoxify metals or chemicals. A pregnant woman’s daily intake of contaminants in air, water and food crosses the placenta in most cases and these contaminate the baby. Some substances can actually be increased through the placenta: for methylmercury, the levels in foetal blood are on average about 70% higher than in the mother’s blood, but can be more than three times as high. (Stern AH, Smith AE. An assessment of the cord blood:maternal blood methylmercury ratio: implications for risk assessment. *Environmental Health Perspectives*. 2003; 111:1465-70.)

## 2. Breast milk and formula feeds

Human babies are born far more immature than most other species. Much of the development that occurs after birth is enabled by breast milk. Breast milk assists in developing the baby's immune system, which helps reduce the severity of a wide range of diseases including respiratory illness, gastrointestinal infections and allergies. Breastfeeding also contributes in many important ways to brain development. Breastfed babies, compared to formula-fed babies, are more mature, more secure, score higher on developmental tests, have higher IQ, a more rapid development of vision, better motor skills and fewer emotional and behavioural problems. Unfortunately, breast milk nowadays contains many artificial chemicals such as pesticides, flame retardants (PBDEs) and heavy metals. Fat-soluble substances found, such as DDT, PCBs, dioxins and PBDEs, are of particular concern. Fat-soluble substances are released from the mother's own fatty tissues. During lactation, maternal fat stores provide about 60% of the fat that goes into breast milk, whereas 30% comes from the mother's diet and 10% is newly synthesised in the breast. (Schreiber JS. Parents worried about breast milk contamination. What is best for baby? *Pediatr Clin North Am.* 2001; 48:1113-27.) However, the beneficial effects of breastfeeding may protect against the adverse effects of some environmental pollutants, as in the case of PCBs. Children born to mothers and exposed to PCBs before birth were more likely to have cognitive dysfunctions including impaired speech development if they were not breastfed, compared to children who were breastfed. (Jacobson JL. Jacobson SW. Breast-feeding and gender as moderators of teratogenic effects on cognitive development. *Neurotoxicology & Teratology.* 2002; 24:349-58.)

The alternative to breastfeeding – infant formula – however is not free of contaminants either. Infant formulas may contain toxic metals such as lead, aluminium, cadmium, PCBs, dioxins and phthalates. Reconstitution with water will add the contaminants found in water.

## 3. Indoor air pollution and dust

Children nowadays spend the majority of their time indoors, mostly in the home. The two major contaminants in the home are indoor air and dust. The US Environmental Protection Agency considers indoor air pollution to be one of the top five environmental hazards to human health. Concentrations of some indoor air pollutants are up to 100 times higher than outdoors. For some pollutants, such as lead and pesticides, indoor sources appear to be of greater importance than outdoor sources.

Studies of indoor dust also found a large number of different chemicals originating from consumer products:

- Phthalates, probably originating from vinyl flooring and any other softened plastics such as shower curtains.
  - Alkylphenol compounds used in cosmetics.
  - Brominated chemicals used as fire retardants in furniture or electronics.
  - Organotin compounds used to stabilise PVC plastics or to kill dust mites in carpeting.
  - Short-chain chlorinated paraffins used in plastics, paints and rubbers.
  - Residues of pesticides and heavy metals.
- A wide array of **volatile organic compounds (VOCs)** are emitted by products used in home, office, school, and arts/crafts and hobby activities. These products, which number in the

thousands, include personal items such as scents and hair sprays; household products such as finishes, rug and oven cleaners, paints and lacquers (and their thinners), paint strippers, pesticides, dry-cleaning fluids; building materials and home furnishings; office equipment such as some copiers and printers; office products such as correction fluids and carbonless copy paper; graphics and craft materials including glues and adhesives, permanent markers; and photographic solutions.

- At room temperature, volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals ( eg formaldehyde, benzene, perchloroethylene). Concentrations of many **VOCs are consistently higher indoors** than outdoors. A study by the US Environmental Protection Agency, found indoor levels up to ten times higher than those outdoors, even in locations with significant outdoor air pollution sources, such as petrochemical plants. (US Environmental Protection Agency. Indoor Air Pollution, An introduction for Health Professionals. 1994.)
- A study by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) found that homes in Melbourne less than a year old had up to 20 times the safety limit of volatile organic compounds (VOCs) recommended by the Australian National Health and Medical Research Council. In England 1 in 20 homes under a year old have levels at least twice that of the Australian limit of 500 micrograms per cubic metre. The British study, which covered 800 houses found that concentrations of VOCs in homes less than a year old were twice as high as in homes built 10 years ago. Five per cent of houses had levels in excess of 1000 micrograms per cubic metre. (Edwards R. When a new house is positively sickening. New Scientist 10 March 2001.)
- In 1996, the Building Research Establishment monitored 174 homes in Avon and found that levels of **formaldehyde** were 10 times higher indoors than outdoors. Twelve homes also exceeded World Health Organisation air quality levels. This was partly due to the cleaning agents used, and partly to gases generated by modern appliances: carbon monoxide, benzene vapour and volatile organic compounds. (The Ecologist, May 2001.)
- The average (10 to 33-year-old) **carpet contains high levels of toxic chemicals**. The chemicals found included pesticides (in one instance equivalent to several hundred applications of a domestic insecticide, permethrin), polychlorinated biphenyls (PCBs), heavy metals such a lead, cadmium and mercury and polycyclic aromatic hydrocarbons. Most of the toxins are brought onto the carpets on the soles of shoes or on pets' paws. Internal sources include cooking fumes, smoking, insecticide sprays, deodorisers and cleaning products. Long-banned chemicals like the pesticide DDT last much longer indoors, where sun, wind and rain cannot break them down. Children are more at risk, because they frequently put their hand in their mouths after touching the carpet. US researchers estimate that the average urban two-year-old breathes in 11 nanograms of benzopyrene a day, the equivalent of smoking three cigarettes. Ninety per cent of UK houses are carpeted, more than in any other European nation. The carpet is the largest reservoir of dust in a house, so that a house with bare floors and a few areas of rugs will have only one-tenth of the dust found in a house with wall-to-wall carpet. (Robert Uhlig. Daily Telegraph. 3.5.2001.)

#### 4. Outdoor air pollution

Air pollution is a significant problem especially in urban areas. The main cause of air pollution is the combustion of fossil fuels, petrol and especially diesel fuels. Particulate matter (PM) consists of a mixture of toxic substances. Each particle is a complex mixture of sulphates, nitrates,

ammonium, carbon, PAHs and toxic metals. Smog is a mixture of ground-level ozone, nitrogen oxide and other toxic gases and PM. Additional air contaminants include more than 600 different VOCs, many of which are released when burning fossil fuel. Other sources include steel-making, petroleum refining, solvent use (both in industry and at home), paints, manufacturing of synthetic materials such as plastics and carpets, food processing, agriculture and wood processing.

- It is estimated that every year, there are **8,100 deaths from particulate matter** and **3,500 deaths because of sulphur dioxide** in urban areas of Great Britain. The numbers of deaths by **ozone** in both urban and rural areas of Great Britain during summer ranges between **700 and 12,500** depending on which threshold for ozone is used. (Committee on the Medical Effects of Air Pollutants – COMEAP; 1998. The Quantification of the Effects of Air Pollution on Health in the United Kingdom HMSO.)
- In a comprehensive study in Southern California it was observed that toxic air pollution posed an excessive cancer risk for millions of people in the Los Angeles region. For every million residents, about 1,200 to 1,400 were at risk of **contracting cancer** from hazardous air pollutants, ranking dirty air as one of the most dangerous environmental health hazards. The study found that diesel exhaust from buses and trucks constituted about 71% of the hazard; other vehicles accounted for about 20% of the harmful emissions; and refineries and factories made up the balance. (Elizabeth Shogren. EPA Says Toxic Chemicals Pose Added Cancer Risk. Los Angeles Times June 1, 2002)
- People living in cities were **more likely to die younger because of pollution**. A study carried out at the Harvard School of Public Health in Boston in 1993 compared death rates and pollution levels in six US cities. It found that the death rates increased in almost direct proportion to the level of pollution. They suggested that people living in the most polluted city, Steubenville in Ohio, were at greater risk of dying young - by 26% - compared with residents of the cleanest city, which was Portage, Wisconsin. (BBC News: City dwellers 'dying younger.' 2 August 2000.)

## 5. Food

Children are exposed to a large number of chemicals in food and breast milk. These substances comprise contamination by pollution, pesticides, toxic metals and food additives such as preservatives, colourings, flavour enhancers and others.

- Today's children are brought up on a diet that consists of a significant proportion of **processed foods**, including 'fast foods', far more so than in the past. Processed foods contain far more fat, sugar and salt than non-processed foods. In addition, processed foods contain artificial substances such as trans fatty acids with problematic health effects.
- There are some toxins for which **food and water are the major sources** of human exposure. Substances that build up in the food chain do so because they are 'lipophilic', which means fat-soluble. These substances, when persistent in the environment, (PCBs, dioxins, organochloride pesticides) build up in fat tissue and concentrate up the food chain. For the persistent organic pollutants such as PCBs, dioxins and banned pesticides such as DDT, the major sources are foods and breast milk. The same is true for bisphenol A (used in resins, dyes, flame retardants and dental sealants).

- **Phthalates**, which are used in numerous plastic products, food packaging and cosmetics, major sources are food in plastic packaging, contaminated fish and fatty foods.
- **Methylmercury** exposure also occurs mainly through food, especially in certain fish. Many foods also contain pesticide residues.

### 5.1 Food preparation – processed food

It is likely that many of the chronic diseases we see currently in western societies are due to a significant change in our diet:

*‘A comprehensive survey of epidemiological studies also suggest that the dominating illnesses in modernised societies are new, or have become newly prominent, in the past 100-150 years. Moreover, when traditional societies modernise today, they, too, seem to develop these same ‘modernisation diseases’ within a few decades. These illnesses include schizophrenia and probably other behavioural disorders, ranging from neuroses to delinquency and criminality; ischaemic heart disease and hypertension; major types of cancer, tinnitus and Meniere's disease, cystic fibrosis; coeliac disease and probably other immune disorders; arthritis, obesity; appendicitis; possibly irritable bowel syndrome, various endocrinopathies and the drying and scaling dermatoses.’* (Rudin DO, Omega 3 essential fatty acids in medicine. In Bland, 1984-85 Yearbook of nutritional Medicine. Keats, New Canaan, Connecticut 1985 p 46.)

Is it not conceivable that the origins of many of the chronic diseases we see in adulthood today are already established through poor nutrition in childhood?

One of the favourite UK foods is ‘chips’. Apart from the problem of a high fat and calorie content, we need to recognise that frying foods, especially high carbohydrate foods, at high temperature produces acrylamide, classified as probable carcinogen. Swedish research found that while their raw ingredients contained no detectable levels of acrylamide, crisps contained levels 500 times more than the WHO maximum recommended level for drinking water. French fries contained levels 100 times more.

### 5.2 Trans Fatty Acids in foods - major contributors to the epidemic of heart disease?

Trans fatty acids are an example of an artificial food component introduced into many foods since the early 20<sup>th</sup> century. Trans fatty acids (trans fats) are a specific type of fat formed when liquid oils are made into solid fats like in margarine. Trans fats are also found naturally in small amounts in certain foods ( eg, dairy products, beef and lamb). Trans fats are found in foods made with or fried in partially hydrogenated oils. Most of the trans fat comes from commercially baked and fried foods. French fries, donuts, pastries, muffins, croissants, cookies, crackers, chips and other snack foods are high in trans fatty acids. In fact, nearly all fried or baked goods have some trans fats. The trans fat content of these foods may be as high as 45–50 percent of the fat. A recent review by the Departments of Nutrition and Epidemiology, Harvard School of Public Health, analyses the dangers of trans fatty acids, in particular the association with coronary heart disease. (Asherio, A; Stampfer MJ and Willett WC. Trans fatty acids and coronary heart disease. Background and scientific review. Harvard College. November 15, 1999.)

While this is an inquiry into childhood and health, we need to consider the possibility that the ingestion of trans fats since childhood could contribute to the epidemic of heart disease.

## **A) Background**

- Trans unsaturated fatty acids, or trans fats, sometimes called hydrogenated vegetable oils, are solid fats produced artificially by heating liquid vegetable oils. This process, partial hydrogenation, causes carbon atoms to bond in a straight configuration ('trans') and remain in a solid state at room temperature. Naturally occurring unsaturated fatty acids have carbon atoms that line up in a bent shape ('cis'), resulting in a liquid state at room temperature.
- Commercial production of partially hydrogenated fats began in the early 20th century and increased steadily until about the 1960s as processed vegetable fats displaced animal fats in the diets of the U.S. and other Western countries. Lower cost was the initial motivation, but health benefits were later claimed for margarine as a replacement for butter. Although the average level of trans fat in margarines has declined with the advent of softer versions, per capita consumption of trans fatty acids has not changed greatly since the 1960s because of the increased use in commercially baked products and fast foods.
- Many fast foods contain high levels of trans fatty acids. There are no labelling regulations for fast food, and it can even be advertised as cholesterol-free and cooked in vegetable oil. One doughnut adds 3.2 g of trans fatty acids and a large order of French fries contains 6.8 g of trans fatty acids. (American Heart Association, Trans Fatty Acids; on [www.americanheart.org](http://www.americanheart.org))

## **B) What are the health effects of trans fats?**

- Concerns have been raised for several decades that consumption of trans fatty acids might have contributed to the 20th century epidemic of coronary heart disease. (Booyens J, et al. The role of unnatural dietary trans and cis unsaturated fatty acids in the epidemiology of coronary artery disease. *Med Hypotheses* 1988; 25:175-182.)
- Trans fats have adverse effects on blood lipid levels -increasing LDL cholesterol (low-density lipoprotein, the 'bad' cholesterol) while decreasing HDL cholesterol (high-density lipoprotein cholesterol, the 'good' cholesterol). This combined effect on the ratio of LDL to HDL cholesterol is double that of saturated fatty acids. (Mensink RPM, Katan MB. Effect of dietary trans fatty acids on high-density and low-density lipoprotein cholesterol levels in healthy subjects. *N Engl J Med* 1990; 323:439-45.) Thus individuals who are replacing butter with margarine high in trans fat to reduce their risks of coronary disease may obtain no benefit or may even increase their risk.
- The relation between trans fatty acids intake and risk of coronary disease has now been reported from three large prospective studies: the Health Professionals Follow-up Study (Ascherio A, et al. Dietary fat and risk of coronary heart disease in men: cohort follow up study in the United States. *BMJ* 1996; 313:84-90.) , the Alpha-Tocopherol Beta-Carotene study (Pietinen P, et al. Intake of fatty acids and risk of coronary heart disease in a cohort of Finnish men: The ATBC Study. *Am J Epidemiol* 1997; 145:876-887.) and the Nurses Health Study (Hu FB, Stampfer MJ, Manson JE, et al. Dietary fat intake and the risk of coronary heart disease in women. *N Engl J Med* 1997; 337:1491-1499.) A pooled estimate of the results of these three studies gives on average a 31% increased risk of developing heart disease for an increase in trans consumption of 2% of energy intake. The studies provide strong evidence that trans fatty acids consumption increases substantially the risk of heart disease.
- The Harvard review calculates the following figures for the number of deaths that may be due to consumption of trans fatty acids from partially hydrogenated fat assuming they constitute

2% of energy (approximately the U.S. average). In the US, approximately 30,000 premature coronary heart disease deaths annually could be attributable to consumption of trans fatty acids. (Willett WC, Ascherio A. Trans fatty acids: Are the effects only marginal? *Am J Public Health* 1994; 84:722-724.) By a conservative estimate, replacement of partially hydrogenated fat in the U.S. diet with natural unhydrogenated vegetable oils would prevent approximately 30,000 premature coronary deaths per year. Epidemiologic evidence suggests this number is closer to 100,000 premature coronary deaths avoided annually. This is nearly a quarter of all coronary deaths.

- Similar figures have been calculated for the Netherlands, where the reduction in trans fat consumption from 4.3% to 1.9% of energy intake in between 1985 and 1995 is thought to have prevented about 23% of coronary deaths. (Oomen CM, et al. Association between trans fatty acid intake and 10-year risk of coronary heart disease in the Zutphen Elderly Study: a prospective population-based study. *Lancet* 2001; 357: 746-51. And: Aro A. Complexity of the issue of dietary trans fatty acids. *Lancet* 2001; 357: 732-33.) On this basis, further reductions in the trans fat content of fast food and confectionary are likely to be required.
- A recent analysis for the UK estimates the dietary intake of trans fatty acids at around 1.3% of total energy intake. The consumption estimate was based on a seven day survey of 8,000 households carried out by in 1994. The mean total fat intake was 77g/day, equivalent to 35.7% of energy intake. Mean trans fatty acid consumption was 2.8g/day (= 1.3% of energy) and 28.5g/day (= 13.2% of energy) was as saturated fatty acids. (Hulshof KFM et al. Intake of fatty acids in Western Europe with emphasis on trans fatty acids: the TRANSFAIR study. *European Journal of Clinical Nutrition* 1999; 53: 143-57.)

### **5.3 Imbalance between omega 3 and omega 6 fatty acids – does this contribute to depression, ADHD and behavioural disturbances in children?**

There has been a very significant increase in the number of children and adolescents with depression. It is estimated that one in eight adolescents now has depression, a very significant increase over the past decades. Suicide is now the third leading cause of death for 10 to 19 year olds. (BBC News, 3 August, 2004).

As mentioned previously, there has been a significant increase in conditions such as ADHD, autism and behavioural disturbances among children. While there are many factors contributing to depression in children, many health professionals are not aware of the contribution of environmental toxins and poor nutrition to all of these conditions. Due to lack of space, we shall only focus on the role of omega 3 fatty acid deficiencies in the development of these conditions. In a 'modern' diet, there is usually a deficiency of these essential fatty acids.

#### **A. Background**

Omega-3 fatty acids are long-chain, polyunsaturated fatty acids (PUFA) of plant and marine origin. Because these essential fatty acids cannot be synthesized by the human body, they must be derived from dietary sources. Flaxseed, hemp, canola and walnut oils are all rich sources of the parent omega-3, alpha linolenic acid (ALA). Dietary ALA can be metabolized in the liver to the longer-chain omega-3 eicosapentaenoic (EPA) and docosahexaenoic acid (DHA). This conversion is limited in human beings. It is estimated that only 5–15% of ALA is ultimately converted to DHA. Ageing, illness and stress, mineral and vitamin deficiencies as well excessive amounts of omega-6 rich oils (corn, safflower, sunflower, cottonseed) can all compromise conversion as can trans fatty acids. Dietary fish and seafood provide varying amounts pre-formed EPA and DHA.

The dietary intake of omega-3 fatty acids has dramatically declined in Western countries over the last century. North American diet currently has omega-6 fats outnumbering omega-3 by a ratio of up to 20:1. There are a number of reasons for this skewed ratio, most notably the mass introduction of the omega-6 rich oils into the food supply, either directly or through animal rearing practices. The ideal dietary ratio of omega-6 to omega-3 has been recommended to be approximately 2:1. Approximately 20% of the dry weight of the brain is made up of polyunsaturated fatty acids (PUFA). One out of every three fatty acids in the central nervous system (CNS) are PUFA. (Logan AC. Omega-3 fatty acids and major depression: A primer for the mental health professional. *Lipids in Health and Disease* 2004, 3: 25ff.)

### **B. Function of omega 3 fatty acids in the brain**

Omega-3 fatty acids are an essential component of brain cell membranes and are therefore critical to the dynamic structure and function of the brain. Omega-3 fatty acids can alter brain membrane fluidity by displacing cholesterol from the membrane. An optimal fluidity, influenced by EFAs, is required for neurotransmitter binding and the signaling within the brain cell.

The second area where omega-3 fatty acids may exert significant influence in depression is via cytokine modulation. There is an association between depression and the production of proinflammatory immune chemicals. These cytokines, including interleukin-1 beta (IL-1 $\beta$ ), interferon, and tumour necrosis factor alpha (TNF- $\alpha$ ), can have direct and indirect effects on the CNS. Elevations of IL-1 $\beta$ , and TNF- $\alpha$  are associated with the severity of depression.

Psychological stress can cause an elevation of these cytokines.

### **C. Depression due to nutritional deficiencies?**

Over the last 100 years, the age of onset of major depression has decreased, and its overall incidence has increased in Western countries. The increases in depression, up to 20-fold higher post 1945, cannot be fully explained by changes in attitudes of health professionals or society, diagnostic criteria, reporting bias, or other artifacts. Could nutritional imbalances – for example the ratio of omega 3 to omega 6 fatty acids and deficiencies of minerals and vitamins play a role?

- There have been several studies that have shown a benefit from supplementing omega-3 fatty acids in **depression**. The first small clinical study showed that four months of treatment with 9.6 g of omega-3 fatty acids (6.2 g EPA/3.4 g DHA) was of therapeutic value in bipolar disorder ('manic depression'). Specifically, this study showed a highly significant effect in treating depression. A study involving patients with treatment resistant depression, showed that EPA had an effect on insomnia, depressed mood, and feelings of guilt and worthlessness. There were no clinically relevant side effects noticed.
- In a small study just 1 g of EPA could reduce **aggression** and depressive symptom scores among borderline personality disorder patients.
- 1 – 4 g of pure EPA may be helpful in **anorexia nervosa**, a condition with the highest risk of morbidity and mortality among psychiatric disorders.

It is important to consider the nutrients, which can ultimately improve omega-3 status. Among them, four important dietary factors also relate to depression: zinc, selenium, folic acid and dietary antioxidants.

- **Zinc** levels are lower among patients with depression and a recent study found that 25 mg zinc supplementation per day may improve depressive symptoms .
- Lowered levels of **selenium** have been associated with negative mood scores in at least 5 studies. Selenium plays a significant role in the human antioxidant defence system.

- Low levels of **folic acid** are found among patients with depression. In addition, there are small clinical trials showing a beneficial effect of folic acid in depression, and its ability to enhance the effectiveness of antidepressant medications at just 500 mcg.
- In patients with depression, there are signs of oxidative stress, which can damage brain cell membranes. This may in part be due to a **lack of antioxidants** such as Vitamins C and E and the antioxidant effect of omega 3 fatty acids. (Logan AC. Omega-3 fatty acids and major depression: A primer for the mental health professional. *Lipids in Health and Disease* 2004, 3:25ff.)

#### **D. ADHD, dyslexia, dyspraxia and autism.**

ADHD, dyslexia, dyspraxia, and autistic spectrum disorders not only overlap within the same individuals, but also cluster within the same families. Some psychiatric conditions also appear to be associated with these developmental ones, including depression, bipolar (manic-depressive) disorder, substance abuse, antisocial or other personality disorders and schizophrenia. There is now mounting evidence that abnormalities of fatty acid and phospholipid metabolism play at least some part in each case, and could perhaps help to explain some of their overlap. (Richardson A. The potential role of fatty acids in developmental dyspraxia – can dietary supplementation help? *Dyspraxia Foundation Professional Journal*. 2002)

- In a trial of fatty acid treatment in ADHD children, a supplement of fish oil and evening primrose oil was therefore used, supplying mainly the omega-3 fatty acids (EPA and DHA) as well as a little omega-6. An early report of this study indicated blood fatty acid changes in the treated children that were associated with reduced ADHD symptoms.
- In dyslexia, a small pilot study involved dyslexic children from a special school who also showed features of ADHD, although none of them had a formal ADHD diagnosis. Results showed that compared with placebo treatment, highly unsaturated fatty acid supplementation for three months led to significant reductions in attention problems, anxiety, and disruptive behaviour.
- 117 children with dyspraxia aged between 5 and 12 years received dietary supplementation containing 80% fish oil and 20% evening primrose oil. After 3 months of treatment the changes in motor skills did not differ between the two groups. However, children who received the fatty acid supplement showed significantly better progress in both reading and spelling and had highly significant reductions in ADHD-related symptoms. (Richardson, A.J., Montgomery, P. The Oxford-Durham study: a randomized controlled trial of dietary supplementation with fatty acids in children with developmental coordination disorder. *Pediatrics* 2005; 115: 1360-1366.)

#### **5.4. Food additives**

About 3,500 additives are in use, but not all of these are synthetic compounds. Some are natural products, or synthetic versions of natural chemicals, although this may not mean that they are substances normally consumed. On average, each person in Britain eats 4.5 kg dry weight of additives each year. This is ten times the amount used 30 years ago, but only half the amount eaten by the average American. Those who eat a lot of packaged, processed or take-away foods may eat twice the average amount or more. Children, in particular have a very high intake because many of the manufactured foods that appeal to them are rich in additives.

Most foods and drinks have to be labelled with all additives (apart from flavourings) listed.

Certain items are exempt, such as alcoholic drinks and any food served in a restaurant or café.

Food that is sold unwrapped does not have to be labelled either, including bread, cheese, pate and similar foods, sausage, bacon, cakes and confectionery. Dried fruit is usually treated with sulphur dioxide, but this may not appear on the label – fruit that has not been treated is usually labelled

‘unsulphured’. Even with labelled foods, manufacturers only have to list those additives which they themselves have put in. Another source of ‘hidden’ additives are medicinal drugs. They may contain colours, preservatives and antioxidants. These do not have to be declared on the label. Azo-dyes are among the most troublesome additives, in terms of the numbers of sensitivity cases reported, yet they are widely used in medicines, particularly in syrups given to children. (Jonathan Brostoff and Linda Gamlin. Food Allergy and intolerance. Bloomsbury, London 1989. p 333ff.)

Food additives include

- **Preservatives** (E200-297). These prevent the decay of food through bacteria and fungi. Over 40 are approved for use in Britain. Those most dangerous to health are the nitrates and nitrites (E249-252) which have been used for hundreds of years to make bacon and ham – they are potentially carcinogenic. Because of the long tradition of use, and the fact that the characteristic flavour of bacon cannot be produced in any other way, these preservatives are difficult to outlaw.
- **Antioxidants** (E300-321). These stop fats and oils from going rancid. Those most likely to cause health problems are BHA and BHT (E320 and 321). One study showed BHT to cause behaviour disorders in animals.
- **Emulsifiers, stabilisers and thickeners** (E322-495). These improve texture. The amount that can be used is not limited, but they are restricted to certain foods. Several of those permitted in Britain are banned by the EU because they are potential carcinogens. These include E430, E433 and E435.
- **Colourings** (E100-180). These include both natural and synthetic colourings. There is a new trend towards colours produced by fungal cells or plant cells in culture – because they too can be labelled as ‘natural’, even though we would not consider eating the items from which they are derived. Such colours are sought as replacement for the synthetic colours known as Azo-dyes. Those include colours such as tartrazine, sunset yellow and amaranth. Eighteen of these artificial colours are permitted in Britain – of these eleven are banned in the US and six are not approved in the EU, because they are suspected of being carcinogenic. Two of the ‘natural’ colours – caramel (E150) and vegetable carbon black (E153) – are also potential carcinogens. Carbon black is banned in the US. Apart from their carcinogenic effect, many of the azo-dyes have been reported as causing sensitivity reactions, especially in children.
- **Flavour enhancers** (E620-E635). The most important of these is monosodium glutamate or MSG and its relatives (E620-623). Eating large amounts of MSG is said to produce a set of symptoms known as ‘Chinese Restaurant syndrome’. The symptoms vary considerably, from tightness, chest pains, palpitations, faintness to flushing, sweating, headaches and low blood pressure.
- **Flavourings**. These do not have to be listed on food labels, unlike other additives. There are over 3,000 of these, they do not have E numbers and most have never been properly tested for safety. However, they are used in extremely small quantities, and are assumed to be non-harmful for this reason. Although this may be true for the majority, there are doubts over some flavourings, particularly a group known as the allyl alcohols which are potent toxins. The average person only receive small amounts, but anyone eating large amounts of sweets, crisps and soft drinks would get a much higher dose. (Jonathan Brostoff and Linda Gamlin. Food Allergy and intolerance. Bloomsbury, London 1989. p 333ff.)

## 6. Water

Water is usually treated with chlorine to reduce microbial contamination. However, a number of substances, called disinfection by-products (DBPs) are created by the reaction of chlorine with naturally occurring organic material in untreated water. An important group of DBPs are the trihalomethanes (THMs), including chloroform, a suspected carcinogen in humans, known to cause cancer in animals. Some DBPs are suspected of causing spontaneous abortion, low birth weight and birth defects including neural tube defects. There may be an association of DBPs with childhood cancer. There can be other contaminants in drinking water including pesticides, metals and radioactive substances.

- The level of **pollutants in drinking water** has been steadily rising in recent years. Pollutants run off the land into rivers or seep down through the soil into groundwater. Agriculture makes the major contribution to water pollution. Nitrates, used as fertilisers, run off from fields in many parts of Britain. Tap-water regularly exceeds the EU limit on nitrates. Although nitrates have received a lot of publicity, they are not as worrying as some of the other water pollutants. Small amounts of pesticides also get into the water supply from farm use. Most water authorities do not systematically monitor drinking water for pesticides. Organic solvents are also found in drinking water.
- A study by Imperial College London found the solvent **trichloroethylene** in 36% of the 168 groundwater samples they tested. The level was higher than the limit set by the World Health Organisation in 10% of the samples. Very few of the water authorities systematically check their supplies for solvents or other industrial pollutants. (Jonathan Brostoff and Linda Gamlin. Food Allergy and intolerance. Bloomsbury, London 1989. p 335ff)

## 8. Testing for the toxic effects of chemicals and food additives

The historical record clearly reveals that our scientific understanding of the effects of toxic exposures is not sufficiently developed to predict accurately the impact of toxic substances, especially on children and their development. Essentially, our regulatory regime has failed to protect children.

As testing procedures advance, it has become clear that lower and lower doses are harmful. The historical record shows that “safe thresholds” for known neurotoxins have been continuously revised downward as scientific knowledge advances. For example, the initial “safe” blood lead level was set at 60 micrograms/deciliter ( $\mu\text{g}/\text{dl}$ ) in 1960. This was revised down to 10  $\mu\text{g}/\text{dl}$  in 1990. Current studies suggest that lead may have no identifiable exposure level that is “safe.” The estimated “toxic threshold” for mercury has also relentlessly fallen, and like lead, any level of exposure may be harmful. Such results raise serious questions about the adequacy of the current regulatory regime, which, by design, permits children to be exposed up to “toxic thresholds” that rapidly become obsolete.

It is quite worrying that most chemicals are not tested for their general toxicity in animals or humans, not to mention specifically toxicity to a child’s developing brain. Nearly 75% of the top high production and volume chemicals have undergone little or no toxicity testing. However, the US EPA estimates that up to 28% of all chemicals in the current inventory of about 80,000 have neurotoxic potential. In addition:

- Even when regulated, the risks from chemical exposure are estimated for one chemical at a time, while **children are exposed to many toxicants** in complex mixtures throughout development. Multiple chemical exposures often interact to magnify damaging effects or cause new types of harm. With the exception of pesticides used in the food supply, current regimes

regulate only one chemical at a time and do not take into account the potential for interactions. Since real world exposures are to multiple chemicals, current regulatory standards, based on single chemical exposures, are inherently incapable of providing adequate margins of safety.

- New studies in humans and in the laboratory show that **PCBs and mercury interact** to cause harm at lower thresholds than either substance acting alone.
- A recent 5-year pesticide study suggests that **combinations** of commonly used agricultural chemicals, in levels typically found in groundwater, can significantly influence immune and endocrine systems, as well as neurological function, in laboratory animals.
- **Animal studies** generally **underestimate human vulnerability** to neurotoxins. Animal studies of lead, mercury and PCBs each underestimated the levels of exposures that cause effects in humans by 100-10,000-fold. Regulatory decisions that rely largely on toxicity testing in genetically similar animals under controlled laboratory conditions will continue to fail to reflect threats to the capacities and complexity of the human brain as well as important gene-environment interactions.
- In an analysis on four regulated chemicals – alachlor, atrazine, formaldehyde and perchloroethylene - a significant **discrepancy between industry-funded studies** and independently funded studies in the safety assessment was observed. 161 studies on these chemicals on file at the US National Library of Medicine were analysed. Out of 43 industry-funded studies, only six returned results unfavourable to the chemicals. But in the 118 studies conducted by non-industry researchers, 71 were unfavourable. (Russell Mokhiber. 'Objective' science at auction. *The Ecologist*. Vol. 28. March/April 1988. p. 57f)

#### **A) How industry has withheld data on adverse effects of chemicals.**

Under Section 8 of the US Toxic Substances Control Act (TSCA) any chemical manufacturer who becomes aware of any adverse effect on human health of a chemical substance must report this to the US Environmental Protection Agency (EPA) within 15 days or face a fine of \$ 6,000 per day that reporting is late. For 14 years, the EPA relied on this 'early warning system' until the EPA was engaged in a four-year legal battle with Monsanto over one of Monsanto's pesticides, Santogard PVI. In 1990, Monsanto agreed to pay a fine for failing to report scientific data that the company had acquired in 1981 showing that this pesticide causes tumours in rats. Following this, the EPA sent a letter to all chemical manufacturers urging them to submit any data they had under section 8 of the Toxic Substances Control Act. Following this, an 'amnesty programme' was agreed between the EPA and chemical manufacturing, limiting any fines and liabilities for the chemical industry. While this amnesty was in effect during 1991- 1994, 120 companies sent the EPA over 11,000 studies on reports of adverse health effects of the chemicals on the market that had never entered scientific literature before. (Peter Montague. *Is Regulation possible?* *The Ecologist* Vol. 28. March/April 1998. p 59-61.)

#### **B) Testing food additives.**

New additives are tested very thoroughly, although there are rarely tests on humans – rats, mice, bacteria, and human cells cultures are the main subjects used for testing. There are quite a few reports of illness among food-workers handling certain additives, which raises the question of whether humans might react differently from these test animals. There has also been concern about how well the tests are carried out. A commercial laboratory in America, which was responsible for over 30% of the world's safety testing was found to have been fabricating its data for years. Although the laboratory was closed down, many of the additives that were passed as safe on the

basis of its tests are still in use. Concern has also been raised over the possibility of a ‘cocktail effect’ – the unknown impact of eating two or more additives together. A single meal can contain as many as 60 different additives, yet, surprisingly, the effect of additives in combination is never taken into account when setting safety standards. One test, in which two preservatives were tested together, showed that they had a much greater effect in combination than when eaten separately. (Jonathan Brostoff and Linda Gamlin. Food Allergy and intolerance. Bloomsbury, London 1989. p 333ff.)

### **C) Testing for pesticides**

There are three main types of pesticides used on food crops: insecticides to kill insects, fungicides to kill fungal infections and herbicides to kill weeds. There are over 420 pesticides that can be used legally in Britain, and others are used illegally. Most pesticides leave residues on crops. Unfortunately, there is no legal requirement on growers to observe the ‘safe period’ between the last spraying and the harvest, which should allow residues to be broken down. Health and Safety officers only visit farms on average every 11 years due to shortage of staff. The main burden of testing foods for pesticides falls on local authority Environmental Health Officers who are able to test for about 20 pesticides, only 5% of those used. This means that the use of 400 or so pesticides goes unnoticed. When foods are found with excess pesticide residues, they are simply destroyed, rather than trying to trace the source of food or prevent further misuse of pesticides. (Jonathan Brostoff and Linda Gamlin. Food Allergy and intolerance. Bloomsbury, London 1989. p 335ff.)

### **D) The European Union REACH proposals.**

The EU is currently developing and negotiating a new chemical regulation, known as REACH (Registration, Evaluation and Authorisation of CHemicals). This was initially developed to address widely perceived legislative failures and inadequacies of current chemicals regulations. Under the proposals, the chemical industry will have to provide safety data on chemicals, which will then need to be evaluated to determine their safety for use in different applications. The EU states: *‘The proposed Regulation would replace over 40 existing Directives and Regulations. At the core of the proposed system is REACH a single, integrated system for Registration, Evaluation and Authorisation of CHemicals. REACH would require companies that produce and import chemicals to assess the risks arising from their use and to take the necessary measures to manage any risk they identify. This would reverse the burden of proof from public authorities to industry for ensuring the safety of chemicals on the market.’* (European Union, Press Release, Brussels, 29 October 2003)

### **E) The precautionary principle**

Protecting children from preventable and potentially harmful exposures requires a precautionary policy that can only occur with basic changes in the regulatory process. The inability of the current regulatory system to protect public health is not surprising, considering the disproportionate influence of economic interests in the regulatory process. When there is evidence for serious, widespread and irreversible harm, residual scientific uncertainties should not be used to delay precautionary actions.

## **9. The cost of environmentally induced illness.**

The social, economic and societal costs of environmentally induced illness is staggering. For example, the impact of neurodevelopmental disorders such as ADHD on children and their families is immense. It is estimated, that in the US, 3% of neurobehavioural disorders such as dyslexia, ADHD, diminished intelligence, autism and mental retardation are linked directly to

toxic environmental exposures and that another 25% are caused by interactions between environmental factors and genetic susceptibility of individual children (National Research Council, Committee on Developmental Toxicology, Scientific Frontiers in developmental toxicology and risk assessment. National Academy Press, 2000)

- While we are not aware of UK estimates, data from the US show that the costs of environmental induced disease in children is estimated to be in the region of **\$ 55 billion per year**. This includes \$ 43 billion for lead poisoning, \$9 billion for neurobehavioural disorders such as mental retardation, cerebral palsy and autism, not attributable to lead \$ 2 billion for childhood asthma and \$ 300 million for childhood cancer. (Landrigan P et al. Environmental Pollutants and Disease in American Children. Environmental Health Perspectives. 2002: 110; 721-8)
- An economic benefits analysis indicated that the societal benefits of reducing population blood-lead level by just one microgram per decilitre (1 mcg/dl) were estimated at **\$ 17.2 billion** a year to the US economy. These figures were based on cost calculation for the effects of lead-related reduction in IQ on years of schooling and earnings, as well cardiovascular effects from lead exposure (Schwartz J. societal benefits of reducing lead exposure. Environmental Research 1994. 66: 105-24.)
- A more recent study looks at the societal cost of lost productivity associated with reduced IQ resulting from methylmercury toxicity. The study estimates losses to the US economy of **\$ 8.7 billion annually** (range \$ 2.2 -43.8 billion) of which \$ 1.3 billion (range \$ 0.1 – 6.5 billion) is attributed to mercury emissions from US-based power plants. (Transade L et al. Public health and economic consequences of methylmercury toxicity to the developing brain. Environm. Health Perspect 113:590-96)
- Another study estimates the cumulative annual economic costs to the US and Canada of between **\$ 568 and \$ 793 billion**. (Muir T and Zegarac M, Societal Costs of Exposure to Toxic Substances. Environmental Health Perspectives. 2001: 109 (Suppl 6): 885-903)

**Exposure prevention therefore could result in massive savings in health care, productivity and social cost.**

## **10. 'Emotional toxicity' – the poisonous influence of media exposure.**

This document has so far examined the devastating effect of environmental chemical toxins on child health. However, children are not just physical bodies, but they are emotional and spiritual beings as well. We need to recognise that emotional and spiritual poisons can have negative influences upon child development. While there are many emotional factors that could be considered in this context, for space reasons, we would like to focus just on the adverse effect of media exposure on child health.

### **1. The adverse impact of media on child health and child development – general comments.**

Exposure to media, including watching TV, playing video games, listening to radio and reading magazines has a powerful formative impact on children and young people, including their physical, emotional and spiritual health. Violence, sexual explicitness, certain stereotypes, but also drug and alcohol abuse are common themes of television programmes and some computer games. Young children are impressionable and many may assume that what they see on television or experience in a computer game is real, normal, safe, and acceptable. As a result, television and computer games expose children to damaging behaviour and to sexual imagery and behaviour which is totally inappropriate for their developmental stage.

- Time spent watching TV and playing computer games **exceeds the time spent on physical activity** for most children, and for many children exceeds the time spent with parents.
- British children spend on average **five hours per day** using media – more than in any other European country. In the US a young person graduating from high school has spent more time in front of a TV than at school.
- Television and the media have a major influence on the values and behaviour of young people in addition to the impact on health and educational achievement. The **media replaces parents and teachers** as educators, role models, and as the primary source of information about the world and how to behave. Children find out about sex, drugs, alcohol, violence etc. increasingly through the media rather than through their parents.
- Time spent watching television or playing computer games **takes away from important activities** such as social interaction and development, especially time spent with the family, physical activity including play but also reading and school work.
- Children who watch a lot of television are likely to have **lower grades in school, read fewer books, exercise less, be overweight and are more likely to be verbally and physically violent.**

## 2. TV advertising and the adverse effect on children.

- Advertising often works by **making the viewer feel unhappy with our lives**, anxious and dissatisfied, lacking something. The messages are that you are not OK unless you buy this, wear that brand, wash your hair with, and look like that very slim model. It attacks our self-esteem. Girls in early adolescence are particularly vulnerable to messages about being OK, as they are sensitive about their body image and whether they measure up to the peer group. Recent research indicates that there is a marked link between TV watching, and negative body image and eating disorders in adolescents.
- Younger children under the age of 8 often **cannot tell the difference between the fantasy** presented on television and reality. Children are also adversely influenced by the thousands of advertisements they see each year, many of which are for alcohol, junk food, fast foods, and toys.

## 3. Media exposure and the obesity explosion – the ‘couch potato syndrome’

Child obesity due to poor nutrition and lack of exercise is a "ticking time bomb" for life expectancy levels. The Food Standards Agency (FSA) chairman, Sir John Krebs, said the dramatic increase in childhood obesity meant young people today would have a lower life expectancy than their parents - the first reduction in more than a century. *‘What we are faced with is a situation where, if nothing is done to stop the trend [of childhood obesity], for the first time in a 100 years life expectancy will actually go down, That is an extraordinary reversal of the general gains in health.’* (BBC News; 9 November 2003)

- At the same time where there is an explosion in childhood obesity, there has been a steady increase in the time children spend watching TV, playing computer games or spending time on the internet. While the media alone cannot explain the explosion in childhood obesity, they play a major role in causing the epidemic of childhood obesity. Among 12 to 17-year-olds the prevalence of obesity increases by 2% for every hour spent watching TV. Conversely nearly one-third of childhood obesity could be prevented by reducing TV watching to 0-1 hour per week. (The role of the media in childhood obesity; Henry Kaiser Foundation, 2004)

#### 4. Media exposure and alcohol and drug misuse – glamourising drugs and alcohol.

- The media have consistently depicted the drinking of alcohol or the taking of drugs as socially acceptable. Most television ‘soap operas’ are built around the ‘local’ – the Queen Vic for Eastenders, the Rovers Return for Coronation Street and the Woolpack for Emmerdale. In these programmes, all transmitted before the watershed, excessive consumption of alcohol is regularly depicted. Even in ‘docu-soaps’ excessive alcohol consumption is regularly seen. Programmes about holiday reps and those programmes built around images from public monitoring cameras, tend to present images of peers who are drinking heavily, promoting the excessive intake of alcohol as a norm.

#### 5. Media exposure and sexual behaviour – trivialising and debasing sexual relationships.

There has been a dramatic increase in sexually transmitted diseases especially among young girls in the UK over the past decades. One of the principal government advisors on sexual health, Professor Michael Adler wrote recently: *‘It is no exaggeration that we now face a public health crisis in relation to sexual health. The past decade has seen a continuing and considerable deterioration in the nation’s sexual health. All infections have increased alarmingly, teenage pregnancies are yet to decrease and changes in sexual behaviour can only continue to drive this situation.’* (Professor Adler in an editorial of the journal Sexually Transmitted Infections, April 2003) Sexually transmitted diseases – many of which cannot be cured - have long-term consequences especially for adolescent girls contributing to pelvic inflammatory disease, future infertility, and cancer of the genital tract. Sexually transmitted diseases have risen sharply over recent years, one of the major contributors has been the dramatic increase in explicit depictions of sex in the media over the same period of time.

- There has been a steady **increase in the amount of sex portrayed in the media**, especially on TV but also in magazines. There appears to be a fairly consistent sexual message: most portrayals of sex depict or imply heterosexual intercourse between unmarried adults, and with promiscuity presented as the norm. However there is little reference to sexually transmitted infections (STIs) and AIDS, pregnancy, or the use of contraception.
- The sexually explicit messages which are daily portrayed by the media have a formative influence on children’s and adolescents sexual behaviour, possibly more so than the influence of parents and the educational system. We are therefore particularly concerned about misleading, inaccurate and **unrealistic information about sex** which will be taken as ‘fact’ by young people. For example, how many people in soap operas – in contrast to ‘real life’ – contract an STI or become pregnant following casual sex?
- The media have consistently depicted sexual adventure and unstable sexual relationships as socially acceptable. In television ‘soap operas’ such as Eastenders, Coronation Street and Emmerdale, all of which are transmitted before the watershed, **marital and sexual infidelity is regularly depicted**. The constant featuring of sexual activity via television, because of the need for ‘exciting’ (albeit unrealistic) story lines, inevitably leads to sexual curiosity occurring before sexual competence is reached.
- On television, abstinence among teenagers is rarely portrayed in a positive fashion. Modesty is mocked and chastity ridiculed. Analyses show that the average American teenager will view nearly **14,000 sexual references**, innuendoes, and jokes **per year, yet only 165 of the references will deal with such topics as birth control, self-control, abstinence, or STIs**. On soap operas - which are extremely popular with teenage and pre-teenage girls - the sexual content has more than doubled since 1980. Soap opera sex is 24 times more common between

unmarried partners than between spouses. From Music Television (MTV), 75% of concept videos (videos that tell a story) involve sexual imagery, over half involve violence, and 80% combine the two, portraying violence against women. While we are not aware of similar British data, we expect similar findings on British TV, especially since many American series are shown here. (Sexuality, Contraception and the Media. A Policy statement of the American Academy of Paediatrics. Paediatrics, Volume 95, February 1995, p. 298-300.)

## 6. The adverse effect of media violence.

There has been a significant increase in the exposure of children to TV and media violence, not only in TV programmes but also through violent computer games at the same time as there has been increasingly aggressive and violent behaviour among children.

The typical American child will view more than 200,000 acts of violence, including more than 16,000 murders before age 18. Television programmes display 812 violent acts per hour; children's programming, particularly cartoons, displays up to 20 violent acts hourly. Viewing media/TV violence can lead to increased antisocial or aggressive behaviour, desensitisation to violence (becoming more accepting of violence in real life and less caring about other people's feelings), or increased fear of becoming a victim of violence. There is also a direct link between violent video games and violence and aggression. It is estimated that playing violent video games contributes up to one-fifth to the increase in adolescent violence. Decreasing the time spent watching TV and playing video games significantly reduces physical and verbal violence in children.

- Exposure to media violence results in many physical and mental health problems for children and adolescents, including **aggressive behaviour**, desensitisation to violence, fear, depression, nightmares, and sleep disturbances.
- Prolonged exposure to violent media portrayals results in increased **acceptance of violence** as an appropriate means of solving problems and achieving one's goals. Television, films and videos normalise carrying and using weapons and glamorise them as a source of personal power in a world, which is perceived to be increasingly dangerous and violent.
- Television exposure during adolescence has also been linked to subsequent aggression in young adulthood. A 17-year study concluded that teens who watched more than one hour of TV a day were almost **four times as likely** as other teens to commit aggressive acts in adulthood.
- In July 2000, the American Academy of Pediatrics, the American Academy of Child & Adolescent Psychiatry, the American Psychological Association, the American Medical Association, the American Academy of Family Physicians, and the American Psychiatric Association issued a joint statement that concluded: *'At this time, well over 1,000 studies point overwhelmingly to a causal connection between media violence and aggressive behaviour in some children.'* ([www.aap.org/advocacy/releases/jsttmtevc.htm](http://www.aap.org/advocacy/releases/jsttmtevc.htm))
- Research has shown that the strongest factor contributing to violent behaviour is previous exposure to violence. Epidemiologists studying factors associated with violence, including poverty, racial discrimination, substance abuse, inadequate schools, joblessness and family dissolution, found that exposure to **violent media was a factor in half of the US 10,000 homicides** committed each year.
- 1st and 2nd graders were observed before and after television was introduced to their remote town. Their **aggression levels increased 160%** after two years of TV exposure.

- A study begun in the early 1960s found that boys who watched more television had higher levels of aggression at age 8, a history of aggressive behaviour at age 19, and were more violent with their children and had been convicted of **more violent crime** by age 30.
- The findings of hundreds of studies, analyzed as a whole, showed the strength of the relationship between television exposure and aggressive behaviour to be greater than that of calcium intake and bone mass, condom non-use and sexually transmitted HIV, lead exposure and lower I.Q., or passive tobacco smoke and lung cancer, associations upon which we routinely base public health interventions. Children learn the ways of the world by observing and imitating - they cannot help but be influenced by media. (Michael Rich, American Academy of Pediatrics; Public Health Summit on Entertainment Violence Washington, DC, July 26, 2000.)
- ‘Video games’: Research to date indicates that interactive media have an even more potent and lasting effect on violent behaviour than passive media forms like television and movies. After playing violent video games, children become **desensitized to violence** and act in a hostile manner toward others. Desensitization increases with greater realism of media violence – newer generations of video games are using better graphics capabilities to increase the gore, showing blood and body parts, or to add digital images such as recognizable faces on victims.
- On April 20, 1999, two heavily armed adolescent boys walked into **Columbine High School** in Littleton, Colorado and shot to death 12 of their schoolmates and a teacher before killing themselves. When authorities investigated, they discovered that the boys had used weapons similar to those issued in their favourite “first person shooter” video game. Their own versions of the game had been modified to occur in a layout identical to that of their high school with the yearbook photographs of their schoolmates electronically pasted onto the game’s imaginary victims.’ (Public Health Summit on Entertainment Violence Washington, DC, July 26, 2000; Michael Rich, American Academy of Pediatrics.)

## 11. ‘Spiritual toxicity’ - children as casualties of the explosion of the occult

Over the past decade, there has been an explosion of interest in the occult and occult activity especially among children and adolescents. There has been a significant increase in TV programmes depicting occult activity, such as witchcraft and associated activities such as casting spells. The Harry Potter books include descriptions of witchcraft and are among the best selling books for children. The Internet is increasingly becoming an easily accessible resource for children to find easily thousands of websites with information on satanism, blood-letting, witchcraft, casting spells, contacting demons or the dead and many other occult activities. While many believe this to be a harmless activity, in our experience, occult involvement has very serious adverse effect on the spiritual, emotional and physical health of children and adolescents. Some of these effects last for many years and can lead – in our experience – to anxiety, fear and depression, both immediately and also many years later.

- In a recent MORI poll conducted for the Association of Teachers and Lecturers among over 2,600 11-16 year old secondary school pupils, over half of those surveyed (**54%**) were **interested in the occult** and the supernatural, with a quarter (26%) very interested. (MORI Schools Survey Research Study Conducted for the Association of Teachers and Lecturers, 2000)
- The Association of Teachers and Lecturers is concerned that the popularity of children's programmes and books featuring witchcraft could encourage children to search for sinister material on the internet. The Association warned that **children are at risk from satanic and**

**occult material** posted on the internet. Researchers for the union found websites promoting satanism, blood-letting and wicca (witch) magic. The union said interest had been heightened by the huge popularity of television programmes such as Buffy the Vampire Slayer, which is based on a teenage girl who has violent battles with satanic forces. One website found by the union describes in detail how to carry out blood-letting and blood drinking, although it does carry a health warning and advises adults to use blocking software to prevent children from accessing the material. Another site advises how to become a witch, while other websites sell books of spells and herbs for occult rituals. The union said the findings were worrying because children were often more skilled at using the internet than adults. Peter Smith, the general secretary of the ATL, said: "Youngsters can easily visit a choice of hundreds of websites on witchcraft, wicca magic, casting hexes and bloodletting techniques, without any adults having any control as to what they read. This goes beyond the case of reading a Harry Potter story. This represents an extremely worrying trend among young people. Parents and teachers will want to educate children and young people about the dangers of dabbling in the occult before they become too deeply involved." (The Independent, April 22, 2000)

To our knowledge, no systematic studies have been carried out on the effect of the occult on children. We therefore include some anecdotal evidence which shows the seriousness of the situation:

- The Pagan Federation, which represents druids and witches, says it has been "swamped" with calls following teenage programmes featuring 'good witches' such as Buffy the vampire slayer and Sabrina the teenage witch. Pagan Federation's Steve Paine, who is the high priest of a coven, said the hit US drama Buffy and the highly successful Harry Potter books were popular amongst practising witches. The Pagan Federation, which deals with about **100 enquiries a month from youngsters who want to become witches**, does not allow anyone under the age of 18 to become a member. Most of the enquiries are from 14 to 18 year-olds, and are dealt with "reactively" by a specially-appointed youth officer, an Essex based schoolteacher. But the trend is described as "worrying" by John Buckeridge, editor of monthly Christian magazine Youthwork. Mr Buckeridge said: "The growing number of books and TV shows like Harry Potter and Sabrina the Teenage Witch encourage an interest in magic as harmless fun. "However for some young people it could fuel a fascination that leads to dangerous dabbling with occult powers. So what starts out as spooks and spells can lead to psychological and spiritual damage." But pagans say teenagers have always been fascinated with paganism and the Christian Church has failed to satisfy the demand for spirituality in young people. (BBC News; 4 August 2000)
- A teenager, aged 17, who wanted to be a **vampire** cut out the heart of an elderly woman and drank her blood during a **ritual killing**. The teenager committed the "sacrifice" in November last year in Llanfair, Anglesey. Mrs Leyshon's chest was "ripped open" and her heart removed and wrapped in newspaper, which was placed in a saucepan on top of a silver platter. Pokers were left crossed at her feet in the shape of either a cross or inverted cross, the court heard. Roger Thomas QC, for the prosecution, said: "He may now deny it or seek to play it down but we submit that in November 2001 he was fascinated by and believed in vampires. He believed they existed, believed they drank human blood and believed most importantly that they could achieve immortality – and he wanted to be immortal. "What may have started out as a bizarre interest became an obsession and led ultimately to murder. He had decided what he had to do; a sacrifice, the murder of another human being was necessary to achieve his ends." Mr Thomas said. (Boy, 17, 'cut out woman's heart to be a vampire'. The Independent; 17 July 2002)

- **Voodoo rituals** - some involving children - are being carried out in the UK. A reporter attended a ceremony where 30 people watched a ritual involving a young girl with a speech defect. The girl was wrapped in a black sheet and chanted over by a group of men wearing white satin robes. Based in a disused warehouse in east London, the sect was examined by police investigating the dismembered torso of a young boy found in the Thames. The vice-chairman of the Metropolitan Police Independent Advisory Group, John Azah, said he had been brought in by police for a new perspective on the murder. He told Today: 'His head had been cut off in a particular way, his arms and his legs had also been cut off in a particular way. We are talking about either witchcraft, ju-ju or voodoo.' (BBC News; 8 March 2002)
- A young married couple who admitted to a **ritual satanic killing** were yesterday told they could spend the rest of their lives in a secure psychiatric unit after a trial which has raised the spectre of bizarre underground occult groups in Britain. Manuela Ruda, aged 23, who told a German court she had become a vampire in London, and her husband, Daniel, aged 26, were given prison sentences of 13 and 15 years respectively after admitting to the hacking to death of a friend in their flat in Witten, in the Ruhr valley. The victim, a 33-year-old colleague of Daniel's, Frank Hackert, was targeted as suitable prey for his mild temperament and love of The Beatles, and was lured to their apartment where he was attacked repeatedly with a hammer. Manuela Ruda told the court: "Then my knife started to glow and I heard the command to stab him in the heart." The couple stabbed Hackert 66 times, carving an occult pentagram on his chest and collecting his blood in a bowl and then drinking it. When police broke into the flat they found a scalpel still embedded in his stomach with his body lying beneath a banner saying "When Satan Lives". They also found imitation human skulls and a coffin in which Manuela slept during the day. Manuela had told the court how, after working in the Scottish Highlands, she had headed for north London where she secured a job in a gothic club. It is here she made her first forays into the world of bloodsucking. When she was on the stand, Manuela's lawyer asked her if she had actually signed over her soul to the devil. "That was two-and-a-half years ago, on the night before Halloween," she replied, adding in quasi-Biblical language: "That was when I placed myself in, and swore myself to, the service of our Lord, his will to perform." Manuela Ruda's obsession with Satanism brought her to Britain. Ruda told German police they had visited the UK twice, touring Scotland for five months in 1996 and in February 1997 visiting London. Manuela said: '**I was in England and Scotland, met people and vampires in London.** We went out at night, to cemeteries, in ruins and in the woods.' In London she worked in a gothic club in Islington where she claims to have joined a group who attended "bite parties" and worshipped the Devil. "We drank blood from living people," she told police. "We slept on graves. One time we dug a grave and I slept in it, just to see what it would feel like." Accounts of Manuela's bloodsucking habit and the ritual in which she and her husband killed their victim -- carving a pentagram, the sign of the devil, into his chest and leaving a scalpel protruding from his stomach -- have fascinated Germany and focused attention on Satanism. 'If you study Internet chat pages you can see that the Rudas **enjoy cult status with kids,**' said Ingolf Christiansen, author of a book on Satanism and commissioner for ideological issues at the Lutheran Protestant Church in Hanover. Christiansen said Satanism was more widespread in Britain and the United States than in Germany, where he estimates there are between 3,000 and 7,000 followers. 'That's a conservative estimate. I see a rising tendency. The Internet is helping to spread it. It is driven by increasing brutalisation in all areas and a corresponding loss of values.' Satanism - which has no official structure and means different things to different people - typically involves worshipping Satan, the Devil, and a travesty of Christian practices and symbols. Many adherents see it as a form of social Darwinism rejecting religious norms and promoting the

right of the strong to dominate the weak. Its practice often involves ceremonies with sex and sacrifice to tap dark primal forces. Most Satanists reject moral codes, saying an individual must determine what is good or bad. Modern forms of Satanism draw on a host of traditions, from ancient Egyptian mythology to Celtic cults and Haitian Voodoo. Iain Taylor, of the Evangelical Alliance, said: "There is increasing anecdotal evidence of people becoming involved in satanism, especially children." (The Guardian 1.2.2002; The Independent; 1.2.2002)

## 12. Creating a healthy environment for children

We are all aware that the home environment needs to be ‘childproof’, so that small children do not suffer preventable accidents or ingest chemical substances or drugs not intended for them. This concept of childproofing should be extended to environmental toxins. The first principle is to focus on prevention and to adopt the precautionary principle. The following suggestions are relatively simple steps that reduce the risk to children through environmental toxins.

Some suggestions include (adapted from Child health and the environment – a Primer; Toronto, 2005)

### 1. Healthy lifestyle and healthy diet during pregnancy and breastfeeding.

This is especially important when considering a pregnancy and during the pregnancy.

- This would include advice to stop smoking and especially not to smoke during pregnancy or in a child’s environment.
- During pregnancy, avoid alcohol, but also avoid x-rays and having dental amalgam fillings.
- When breastfeeding, organic food and a diet low in animal fat may reduce the amount of contaminants in breast milk. Breastfeed your baby exclusively for six months.
- While fish is healthy in principle and contains for example omega 3 fatty acids essential for brain development, avoid fish high on the food chain that contain higher concentrations of mercury, such as tuna, swordfish and shark.

### 2. Healthy foods

Foods that are good nutritional choices also tend to have less adverse environmental impact and tend to be less contaminated.

- A diet with whole grains, fruits, vegetables, non-animal protein and low-fat animal products will result in less toxic substances in the body. Do not avoid fish, but follow the above advice. If there is not sufficient fish intake, consider a purified (i.e. low levels of contamination, including mercury and other pollutants) fish oil supplement.
- Fresh food with minimal additives or processing is less contaminated than processed foods. There are also lower levels or no food additives such as colourings, preservatives and flavour enhancers.
- Organic foods tend to have lower levels of contamination.
- Wash and peel all fruit and vegetables, including organic produce.
- Aim for a variety of fruits and vegetables, so that children are not repeatedly exposed to the same types and levels of pesticide residues.
- When there is only limited money available to purchase organic foods, choose organic foods high on the food chain such as dairy, eggs and meat. Choose organic foods if children only eat a limited range of foods.
- Avoid burnt food, particularly from the barbeque to avoid exposure to cancer causing PAHs.
- Avoid heating (especially in the microwave) food or drinks in plastic containers or use plastic films.

### 3. Hand washing and ‘dust busting’

Metals, pesticides and many more substances are tracked in from outdoors and end up in house dust, carpets and other indoor surfaces where they become important sources of exposure to

children. Contaminants in house dust will be concentrated in vacuum bags, dryer lint and cleaning equipment.

Hand-to mouth behaviour, especially in young children, exposes them to whatever is on their hands or other surfaces. Regular hand washing reduces uptake.

The carpet is the largest reservoir of dust in a house. A house with bare floors and a few areas of rugs will have only one-tenth of the dust found in a house with wall-to-wall carpet.

It may be helpful to differentiate between 'clean dirt' and 'dangerous dirt'. 'Clean dirt' is in many parks, playgrounds (although not under arsenic treated wood structures), on many beaches and in the woods. 'Dangerous dirt' is urban street dust, residues on car and urban buildings, lands that is/was used by industry. Indoors 'dangerous dirt' is any deteriorating paint surfaces and associated dust, contents of vacuum cleaner bags, broom surfaces, rags used for cleaning and dryer lint.

- Take your shoes off at the door
- Using doormats that can be washed frequently can prevent very large amounts of dust and dirt entering your home.
- Clean up house dust with moisture such as wet mopping rather than dry cleaning or vacuum cleaner. This avoids simply blowing dust into the air to be inhaled or to settle again on surfaces.
- Do not change the vacuum cleaner bag when you are pregnant and carefully dispose of these bags.
- Avoid contaminating your child's home with 'take home' exposures from parental occupations. Isolate your shoes and clothing especially if you work with chemicals, in the construction industry or other chemical exposures. Remove clothing and shower before occupying rooms and furniture where children are.
- Clothes dryer lint is likely as contaminated as house dust. Dispose of it carefully.

#### **4. Healthy indoor air**

- Regular ventilation helps reduce indoor pollution.
- Do not smoke in the house or in the car.
- Do not let children sleep with pets.
- Follow the advice on safe renovations, reduce toxic exposure and be an informed consumer (see further below)
- See information on moulds, organic solvents, phthalates and PBDEs, VOCs and carpeting.
- Protect your home from carbon monoxide.
- Avoid spraying pesticides on lawns as the chemicals are frequently carried into the house.

#### **5. Outdoor air pollution reduction**

Reducing outdoor pollution is extremely important to help protect children's health. Much of the outdoor pollution originates from the use of cars and the use of energy, such as electricity, the production of which contributes significantly to pollution. To save energy therefore reduces pollution.

- Drive less, car-share, use public transport.
- Encourage children to walk or bike to school
- Choose an energy efficient vehicle and don't idle your vehicle.
- Practice energy efficiency and water preservation
- Avoid busy streets when walking with small children or using pushchairs.

- Never burn plastics or other synthetic materials, such as carpeting or furniture containing foam or that is treated with varnishes.
- Never burn pressure-treated wood (the green-tinged wood that is treated with copper-chromated arsenic)
- Burning coloured paper or cardboard is not advisable as it releases metals and other chemicals used in the colouring.

## **6. Safe at play**

Children need safe play areas. Outdoors they need to be protected from too much UV radiation, their activities should be limited during smog alerts and care should be exerted with insect repellents. Consumer products pose unexpected risks. For example toys, hobby supplies (for example painting) can contain harmful substances. Lead has been found in some crayons and paints. The solvents in glues, adhesives can emit VOCs. Soft plastic toys are made of PVC can contain phthalates that can leach out.

- Prevent UV exposure. Cover up small babies or stay in the shade. Sunscreens are not recommended for babies six months or younger. Children should wear sun hats. Avoid the peak hours of 11 am to 3 pm.
- Arrange outdoor activities to take place away from heavy traffic areas or time activity with low traffic activity.
- Avoid intense outdoor activity when air quality is low.
- Replace arsenic treated wood play structures. Wash children's hands after playing on these structures.
- Adults that have hobbies using or generating toxic substances should do so outside the home or in spaces specifically designed for this. Try to choose low-toxic materials.
- Pregnant women should avoid all activities that involve the use of oil paints, solvents, varnishes, paint strippers, lead compounds (including soldering) or dust producing materials.
- For children's hobbies ensure supervision, use non-toxic products and follow labels, keep information on products (such as original packaging) so you can always read the label,
- Avoid or discard toys made of soft vinyl, particularly those for teething babies.
- Investigate your home for lead- containing consumer products.
- Discourage young girls from using nail polish and polish remover as these can contain hazardous chemicals.
- Discourage young children from using hair dyes, especially permanent dyes and darker colours (suspected in cancer)

## **7. Safe renovations**

Renovations, especially the removal of floors, walls, appliances etc. can release many harmful substances into the environment. Substances released in dust may contain asbestos, mineral fibres, lead, pesticides and mould. New building materials, the adhesives, sealants etc. can release substances including VOCs such as xylene, benzene and formaldehyde, and fungicides. Lead is of particular concern. Asbestos is another significant concern. Homes built or renovated between 1920 and up to about 20 years ago can have asbestos- containing products such as ceiling tiles, asbestos cement on garage or shed roofs, asbestos cement in gutters, drain pipes, infill panels, partitions etc. and asbestos from insulation of heating systems. The principal risk of asbestos is if fibres are inhaled, when it can cause lung cancer and mesothelioma, a cancer of the lining of the chest and abdomen.

- Take extreme care with dust control during renovations, especially of old painted surfaces.
- Pregnant women and young children should be kept out of spaces being renovated until the work is completed and the space has been well cleaned and restored.
- Pregnant women should avoid all home renovation activities. Particular care should be taken to avoid oil paints, solvents, varnishes, paint strippers and dust or other residues created by paint removal.
- Similarly, pre-adolescents and children going through puberty should not be exposed to synthetic chemicals that may disrupt hormone function and should avoid the above mentioned substances.
- If asbestos related materials are undisturbed, it may be better to leave them alone. Do not remove asbestos containing material yourself but rather find a qualified professional.
- Choose low-VOC paints, finishes, adhesives and other products.
- Follow label instructions on home renovation products.
- Deteriorating layers of old paint should always be considered as potential source of lead for pregnant women or young children.

### **8. Be an informed consumer**

We need to recognise that a significant contribution to environmental toxins comes from consumer products. While many people read food labels, many of us do not read the labelling of consumer products to check what potentially hazardous substances may be present in the product. Unfortunately, labelling requirements are not very stringent and labelling is frequently not very clear.

- There is almost always a non-toxic or lower-risk alternative for most products.
- Consumer demand and consumer opinion shape the marketplace. Tell retailers that you appreciate having lower risk or safer alternatives.
- Many recycling options now exist. Find out about recycling options offered by your local council. The UK has one of the lowest recycling rates in Europe.
- Avoid products with multiple hazard symbols.
- Products offered for sale may not necessarily have been tested for safety.
- Inexpensive products, products imported from developing countries may contain hazardous substances because environmental health standards are often lacking.

### **9. Reduce the poisonous influences on children's minds**

Many children spend an enormous amount of their time in front of the TV, playing computer games or on the internet. Many children have a TV in their bedroom, where parents have little or no control over their TV watching habits. TV and media exposure is linked to many adverse health outcomes including childhood obesity, poor nutrition, poorer school performance, aggression, precocious sexual activity and many other adverse outcomes.

- Reduce the time children spend watching TV, playing computer games and – if excessive – on the internet.
- Consider watching TV with children to discuss and question what is being shown on TV.
- Some video games are very violent, consider not allowing children to play them.
- Consider that the lyrics of many songs are very violent, glorify drug taking or encourage sexual experimentation.
- Encourage children (by example) to read more and watch less TV.

- Consider the concept of ‘media literacy’: parents should understand the risks of exposure to violence and teach children how to interpret what they see on television, including the intent and content of TV advertising.
- Even though there has been a dramatic increase of occult programmes on TV, occult information on the internet and occult books, this does not mean that occult involvement is harmless. Parents need to be aware of this and protect their children from occult influences as much as possible.

## **10. Get involved**

Individual action by concerned parents or individuals is necessary. However, the responsibility for cleaning environmental pollution and regulating toxic substances must be shared between manufacturers, retailers and the government. These groups often need to be urged or even forced into action.

- After looking at indoor air quality, dust control and toxic exposure at home, do the same in child care setting, schools, nurseries etc. Are policies in place to ensure healthy indoor air and low-risk playgrounds?
- Insist that manufacturers and retailers secure healthy product designs and lifecycle, that they find safe alternatives to toxic products and processes and that they provide information about non-toxic products.
- Work in your community on the issues you are concerned about.
- Contact your local councillor, MP and Euro-MP, expressing your concerns about toxicity and child health, urging them to take action at local, national and international (especially EU) level. The REACH regulations (see glossary) proposed by the EU could potentially lead to a much safer environment.

### 13. Conclusion

Children grow up today in a physical environment that is enormously toxic. It poisons their bodies. Children now carry in their bodies toxic substances such as pesticides or heavy metals that only one or two generations ago children were not exposed to. At the same time, with the advent of food processing, there have been profound changes in nutrition. This has drastically changed the quality and composition of foods, and lead to clinically significant deficiencies, especially in micronutrients, which have serious adverse effects on health, learning and behaviour.

Worse, children now grow up in a moral and emotional environment which is profoundly toxic. Their minds are poisoned through exposure to media violence and sexual imagery to a degree unthinkable only one or two generations ago. What would have been considered totally unacceptable on TV only one or two decades ago is now broadcast and promoted routinely, even before the 'watershed'. The explosion of the occult in books, TV and the internet is stimulating an increasing fascination with the occult. This has led many children to get actually drawn into occult activity, with devastating consequences for many. Even so, the full adverse effects of occult involvement may not be seen for many years to come.

For generations, it has been one of the motivations of most parents that their children should – one day – have it 'better': for example, have a better education or a higher standard of living. And in the long term, the health of everyone in society will benefit when children are healthier. However, the increasing pollution of our environment, food, water and homes means that many children of this generation may well be worse off than their parents. In terms of the obesity explosion alone, one leading health expert has suggested that many present-day parents may outlive their children. There needs to be a dramatic change in our policies, to deal with child poverty; to reduce air pollution by eliminating all persistent toxicants such as lead and mercury; and as far as possible to remove other known or suspected toxic substances from consumer products. There needs to be a national biomonitoring programme to assess regularly the concentrations of various pollutants in the population, especially in children.

Likewise, we need a dramatic change in the moral environment in which our children are brought up – a reclaiming and protection of family life; a reclaiming of proper nature, context, and joy of sexual activity; and a reclaiming of the ground for truth versus falsehood regarding sound spirituality versus experimentation with the occult.

Children have a right to grow up in a safe environment: safe from poisonous substances, safe from violence, safe from grotesque depictions of violence and persistent portrayal of sexual depravity in the media, and safe from exposure to depictions of occult practices and activity.

We have a responsibility to create a safe and healthy environment for children. Jesus, the Prince of Peace, had only the harshest warning for those, who lead the 'little ones' astray or who would cause them harm in any way: ***'If anyone causes one of these little ones who believe in me to sin, it would be better for him to have a large millstone hung around his neck and to be drowned in the depths of the sea.'*** (Matthew 18, 5-7)

## 14. Further sources of information

### **Canadian Partnership for Children's Health and Environment:**

**Child health and the environment – a Primer**; Toronto, 2005 (This is a superb publication, excellent introduction to the topic)

(Online at: [www.healthyenvironmentforkids.ca/english/resources/card\\_file.shtml?x=2323](http://www.healthyenvironmentforkids.ca/english/resources/card_file.shtml?x=2323) )

**Dr David McKeown, Environmental threats to children. Understanding the risks, enabling prevention. Technical report, Toronto Public Health. 2005.** (available online at... [http://www.toronto.ca/health/hphe/childrens\\_health\\_report.htm](http://www.toronto.ca/health/hphe/childrens_health_report.htm).)

**Greater Boston Physicians for Social Responsibility**; <http://psr.igc.org/>  
**Report: In Harm's way – Toxic threat to child development.**

Maranatha Submission prepared in response to the Consultation on Action to Improve People's Health 'Choosing Health' (2004); available on the Maranatha website  
[www.maranathacommunity.org.uk/documents/sub\\_choosehealth04.pdf](http://www.maranathacommunity.org.uk/documents/sub_choosehealth04.pdf)

Children's Environmental Health Network; [www.cehn.org](http://www.cehn.org)

Reference tool for adverse health effects of specific chemical substances:  
Scorecard; [www.scorecard.org](http://www.scorecard.org)

## Glossary

(adapted from 'Child Health and the Environment' – a primer; Toronto 2005)

**ADHD:** Attention Deficit Hyperactivity Disorder.

**Association:** The relationship between an exposure and a disease. Such a relationship does not necessarily demonstrate a cause-effect relationship.

**Bisphenol A:** An endocrine disruptor used in the manufacture of clear plastic (such as baby feeding bottles) and used in the resin for lining tin cans.

**Birth defect:** Any defect present in a baby at birth, irrespective of whether it is caused by a genetic factor or by non-genetic prenatal events. Common birth defects include heart defects, cleft lip or palate, Downs Syndrome, spina bifida and limb defects. Birth defects are the leading cause of infant mortality.

**Bioaccumulation:** Some pollutants are excreted more slowly than they are absorbed and are thus stored in the body for long periods of time. Total pollutants in the body (the "body burden") may increase if the organism is exposed to bioaccumulating substances for a long period of time.

**Biomarker:** See biomonitoring.

**Biomagnification:** Pollutants "biomagnify" when their concentration increases as animals eat plants or each other. For example, when pollutants in plants are passed on to animals feeding on the plants, the animals may accumulate higher levels of contaminants in their own bodies than were originally found in the plants. This is because the animals eat many plants and do not excrete most of the absorbed pollutants. Levels of contaminants can increase up the food chain.

**Biomonitoring:** Biomonitoring (biological markers) involves measuring and analyzing chemicals, hormone levels or other substances in biological materials (eg, blood, urine, breath) to estimate exposure, or to detect biochemical changes in the exposed subject before or during the onset of adverse health effects.

**Blood-brain barrier:** A term that encompasses multiple mechanisms that control access of blood components to the brain; foetal and neo-natal blood brain barriers tend to be more permeable than adult barriers.

**Body burden:** The total amount of a chemical in the body. Some chemicals build up in the body because they are stored in fat or bone or are eliminated very slowly.

**Carcinogen:** A substance (e.g: a chemical) or an agent ( eg, ionizing radiation) that causes cancer.

**Childhood cancer:** Among all age groups, the most common childhood cancers are leukaemia, lymphoma and brain cancer. As children enter their teen years, the incidence of osteosarcoma (bone cancer) increases. Children who have had chemotherapy or radiation treatment for a prior cancer have an increased risk of cancer. In almost all cases, childhood cancers arise from non-inherited mutations in the genes of growing cells. These mutations occur as a result of toxic influences by certain chemicals, drugs or ionizing radiation.

**Contaminants:** Substances foreign to a natural system or present at unnatural concentrations; unwanted substances that have entered the air, food, water or soil. Contaminants may be chemicals, living things ( eg, bacteria or viruses) or the products of radioactivity. Some contaminants are created by human ( eg, industrial) activities while others are the result of natural processes.

**DDT:** Dichloro-diphenyl-trichloroethane. Insecticide widely used until it was banned in most countries in the 1970s.

**DEET:** N, N-diethyl-m-toluamide. Personal insect repellent for mosquito control.

**Developmental toxicants:** Agents that cause adverse effects to the developing embryo, foetus or child. Effects can include birth defects, low birth weight, biological dysfunctions, or psychological or behavioural deficits that become manifest as the child grows. These effects usually result from maternal exposure to toxic chemicals during pregnancy;

but can also result from paternal exposures. Early postnatal contact with developmental toxicants can also affect normal development.

**Dioxins and furans:** Among the most toxic chemicals known. Carcinogenic and endocrine disruptors. Numerous types in each group, these chemicals are by-products of combustion and some industrial processes. Fatty meats (beef, pork, poultry, fish) and dairy products are responsible for over 95% of human exposure to dioxins.

**EBDCs:** Ethylenebisdithiocarbamates are a group of non-systemic (surface acting) fungicides.

**E-coli:** Bacterial species (numerous strains exist) found in human and animal intestines.

**Endocrine disruptors** (also called hormonally active agents): Synthetic chemicals and natural plant compounds and some pharmaceutical drugs that may affect the endocrine system, the communication system of glands, hormones and cellular receptors that control the body's internal functions. Many of these substances have been associated with developmental, reproductive and other health problems in wildlife and laboratory animals. They may affect humans in similar ways. Most of the substances implicated in endocrine disruption affect the thyroid gland. These include PCBs, PBDEs, dioxins, EBCDs and others. Interference with thyroid function has an especially adverse effect on brain development of the unborn baby.

**Epidemiology:** Often called the science of public health. The study of the distribution and determinants of disease risk in human populations. Also the field of medicine concerned with the determination of the specific causes of localized outbreaks of infection (such as hepatitis), toxic disorders (such as lead poisoning), or any other disease of known cause.

**ETS:** Environmental Tobacco Smoke (second-hand smoke). The smoke released by idling lit tobacco products (cigarettes, cigars, pipes), and smoke exhaled by smokers after puffs. ETS contains hundreds of toxic chemicals, including over 40 cancer-causing chemicals.

**Food chain:** The food chain is a series of organisms, each eating the organisms below them in the chain, and being eaten by the next higher organisms. Green plants are at the bottom of every food chain; green plants convert sunlight into food (chemical) energy for use by the rest of the food chain. Because organisms at each level use up most of the energy they consume, energy is lost at each level of the chain, limiting the length of the chain. With more levels, contaminants can concentrate (biomagnify) to higher levels. Hence the greater contamination of fish by methylmercury compared to land animals that occupy shorter food chains.

**Food web:** Found in any natural community, a food web contains many interlinked food chains. Humans are at the highest level of many food webs and their breastfed infants are higher still.

**Formaldehyde.** Formaldehyde has been classified as a probable human carcinogen. Urea-formaldehyde foam insulation (UFFI), one source of formaldehyde used in home construction until the early 1980s, is now seldom installed, but formaldehyde-based resins are components of finishes, plywood, panelling, fibreboard, and particleboard, all widely employed in mobile and conventional home construction as building materials (sub flooring, panelling) and as components of furniture and cabinets, permanent press fabric, draperies, and mattress ticking. Airborne formaldehyde can also act as an irritant to the conjunctiva and upper and lower respiratory tract.

**Incidence:** The number of new cases of a disease occurring in a defined population within a specified period of time. Frequently presented as the number of new cases per 1,000 or 100,000 people per year.

**Inorganic chemicals:** Chemicals that do not contain carbon. Examples include metals like lead, mercury and cadmium, salt and asbestos.

**Ionizing radiation:** A physical agent - ions - released during the spontaneous radioactive decay into small elements of radionuclides emitted during medical X-rays, the regular operation of nuclear power plants, and in potentially massive amounts, nuclear accidents and the testing or use of atomic weapons.

**Latency period:** The period of time between exposure to a disease causing agent and the first appearance of signs or symptoms of the disease.

**Learning disabilities:** Refers to a number of disorders that may affect the acquisition, retention, understanding or use of verbal or nonverbal information. These disorders affect learning in individuals who otherwise demonstrate at least average abilities essential for thinking and/or reasoning. Learning disabilities result from impairments in one or more processes related to perceiving, thinking, remembering or learning. They range in severity and may interfere with the acquisition and use of one or more of the following:

- oral language ( eg, listening, speaking and understanding);
- reading ( eg, decoding, phonetic knowledge, word recognition, comprehension);
- written language ( eg, spelling and written expression);
- mathematics ( eg, computation, problem solving).

**Lipophilic:** Literally "fat-loving". Used to refer to substances that bind to fat molecules, and as a result often concentrate up the food chain and reach their highest levels in high fat foods, such as whole milk, cheese, fatty meats and oily fish.

**Hydrophilic:** Literally "water-loving." Used to refer to substances that stay in solution in water and tend not to bind to either particles or fatty molecules.

**Low birth weight/intrauterine growth retardation (IUGR):** Lowest birth weight decile adjusted for gestational age/small for gestational age. Low birth weight is a birth weight of below 2,500 grams (approx. 5 lbs). This is associated with many adverse health outcomes and increased mortality.

**Melanoma:** Dangerous type of skin cancer.

**Mental retardation:** A disability characterized by significant limitations both in intellectual functioning and adaptive behaviour as expressed in conceptual, social, and practical adaptive skills. This disability originates before age 18 and is often more simply defined in terms of an individual having an IQ below 70, but other criteria, beyond intellectual capacity, are generally considered.

**Metabolism:** Total biochemical and energy processes that maintain life in organisms. Includes the conversion of one compound into another, the building up of larger molecules from smaller ones (anabolism), and the breakdown of compounds (catabolism) to release life-sustaining energy.

**Mercury:** Mercury toxicity is related to two forms of mercury. There is the elemental, liquid form of mercury found in mercury thermometers or in amalgam used for dental fillings. Elemental mercury usually enters the body through inhalation of mercury vapours. Possibly more toxic is the organic form of mercury, methylmercury. This form of mercury is particularly toxic, as it participates directly in biochemical reactions.

**Methylmercury:** Organic mercury compound which is highly toxic especially to the developing brain of the foetus and of the child. Methylmercury accumulates in the brain. Fish consumption is the principal source of Methylmercury intake for most people. Unfortunately, most fish – an excellent source of omega 3 fatty acids necessary for the brain development - are contaminated by Methylmercury. Concentrations are highest at the top of the food chains such as in swordfish, tuna, king mackerel, shark and many freshwater fish. Foetal exposure to mercury can cause lasting impairment of language, attention and memory. A dramatic incident happened when in the 1950s, mercury contaminated waste was dumped into Minamata Bay, Japan. Hundreds of the local residents who ate fish from the bay died including unborn children. Children born to mothers developed mental retardation, cerebral palsy and delayed walking.

**Neurotoxicants:** A biological or chemical substance or agent that has an adverse effect on the structure or function of the central (including the brain) and/or peripheral nervous system. Toxicants that exert adverse effects on the developing brain or nervous system are called developmental neurotoxicants. There are increasing concerns that degenerative neurological diseases – such as Parkinson's disease - developing later in adult life may be associated with neurotoxic chemicals, such as pesticide exposure.

**Organic chemicals:** Chemicals containing carbon, usually combined with hydrogen and other elements, such as oxygen, nitrogen, or chlorine. Vegetable matter, petroleum and plastics are examples of organic materials, as are PCBs, DDT, and polyvinyl chloride.

**Organic Solvents.** Organic solvents are lipophilic ('fat-loving') and evaporate at room temperature, i.e. they are volatile. They are readily absorbed through the skin, lungs and gastrointestinal tract and are readily distributed through the body, including into the placenta. They accumulate in the body's fatty tissues. They are widely used and found in petrol fumes, lighter fluid, cleaners and disinfectants, degreasers, aerosol sprays, cosmetics, adhesives, laboratory reagents, paints, paint strippers, paint thinners etc. Most dry cleaning is done with a toxic solvent (perchloroethylene). Maternal prenatal exposure to some solvents has been linked to effects on reproduction and the developing nervous system.

**Organochlorine compounds:** A wide variety of synthetic chlorine compounds particularly notable for their persistence and stability. Some have been deliberately manufactured eg, DDT and PCBs, though these are now banned or greatly restricted in use. Others are breakdown or reaction products, such as dioxins formed from incineration of products like PVC plastic. All are now widely distributed in the environment.

**Organophosphates:** Highly toxic pesticides containing phosphorus. Based originally on nerve gas chemistry.

**PAHs:** Polycyclic aromatic hydrocarbons. Large number of toxic chemicals, including several cancer-causing chemicals, created from the combustion of organic material, including fossil fuels. Exposure occurs via air pollution, but most PAHs are adhered to fine particulate matter; unlike VOCs, they are not very volatile.

**PBDEs:** Polybrominated diphenyl ethers. Widely used in consumer products as flame retardants. Lipophilic and stable in the environment for a long time. PBDEs often make up a significant portion of plastics in building materials, TV and computer casings, hand tool housings and foam and fabrics of textiles and furniture. PBDEs are similar to Dioxins in chemical structure and toxic effects. They are likely to be endocrine disruptors, reproductive toxicants and are suspected carcinogens. They tend to accumulate in the food chain and therefore are found in highest concentrations in high-fat foods. Apart from food, indoor air and house dust are the other major sources of exposure. Two of the three most widely used PBDEs have been banned by the EU in 2003 but continue to be produced in many other countries.

**PCBs:** Polychlorinated biphenyls. Manufactured for transformer cooling oils and numerous other applications. Much restricted use because of carcinogenic properties and persistence in the environment. Fatty meats (beef, pork, poultry, fish) and dairy products are responsible for over 95% of human exposure to PCBs. Humans and animals exposed to low levels of PCBs as foetuses have learning disabilities. Children exposed to PCBs during foetal life show IQ deficits, hyperactivity, and attention deficits when tested years later.

**Persistence:** Refers to chemicals or agents that remain a long time in the environment. For example, lead and mercury persist in the environment because they are stable elements; PCBs are chemically stable compounds that resist degradation. Mercury and PCBs cycle between environmental media, including air, water and food chains.

**Pesticides:** A collective term for chemicals whose properties are capable of killing unwanted organisms. These include herbicides, which kill plants, insecticides which kill insects, fungicides which kill fungus and other substances. Many foods contain pesticide residues. Peeling and washing can remove some pesticide residues.

**Phthalates:** (pronounced 'thalates') Compounds widely used to make some plastics soft and flexible and used in many consumer products. Some are added to PVC plastics to make them more soft and flexible, and they are also added to a wide range of cosmetics. Since they can leach (leak) out of their products they can lead to significant human exposures. Many of them are marketed for use by children such as soft plastic toys, nail polish and raincoats. Major sources include food in plastic packaging, especially fatty food and fish, cosmetics and indoor air, where they are released from plastic materials and flooring. They may have multiple health effects including endocrine disruption. Due to safety concerns there is currently an EU ban on their addition to young children's (under the age of 3 yrs) toys intended to be placed in the mouth eg dummies and teething rings.

**REACH:** Proposed EU Regulation for chemicals. REACH stands for Registration, Evaluation and Authorisation of CHemicals. REACH would require companies that produce and import chemicals to assess the risks arising from their use. This would reverse the burden of proof to industry for ensuring the safety of chemicals on the market.

**TCO eco label:** An environmental labelling scheme for computer equipment operated by The Swedish Confederation of Professional Employees (TCO). Established in 1992 (TCO1992) the scheme has been updated twice since then in 1995 and 1999. The current requirements (TCO99) cover a wide range of issues; environment, ergonomics, usability, emission of electrical and magnetic fields, energy consumption, and electrical and fire safety.

**Polychlorinated naphthalenes:** Chemicals used for cable insulation. Persistent and bioaccumulative and recommended by the European Commission (in 2004) as candidates for addition to the Stockholm Convention on Persistent Organic Pollutants.

**POPs:** Persistent organic pollutants. Chlorinated organic compounds characterized by resistance to natural breakdown with a consequent persistence and bioaccumulation in the environment. Also often highly toxic.

**Prevalence:** The number of events ( eg, instances of a given disease or other condition in a given population at a designated time). Note, this is a number not a rate. See also Rate and Incidence.

**PVC:** Poly Vinyl Chloride. A plastic polymer (large molecule) with many different uses. Its physical characteristics are altered ( eg made flexible) by the addition of different chemical additives, some of which are of concern. PVC also releases dioxins upon burning.

**Rate:** In epidemiology, an expression of the frequency with which a certain circumstance ( eg, asthma incidence in children) occurs in relation to a certain period of time, a fixed population, or some other fixed standard. The use of rates, rather than raw numbers, is essential for comparison of experience between populations at different times or different places.

**Reproductive toxicants:** Chemical substances or agents that cause adverse effects on the male and female reproductive systems. Toxicity may be expressed as alterations of sexual behaviour, decreases in fertility, or loss of the foetus during pregnancy ('spontaneous' abortion). Interference with sexual function may occur from puberty through adulthood.

**SCCPs:** Short-chained chlorinated paraffins. Chemicals used in metal working and leather finishing, and recommended by the European Commission (in 2004) as candidates for addition to the Stockholm Convention on Persistent Organic Pollutants.

**SIDS:** Sudden Infant Death Syndrome (also called cot death). Refers to the sudden and unexpected death of apparently healthy babies. Exact cause is unknown, but risk factors include exposure to environmental tobacco smoke and sleeping on the stomach.

**Teratogen:** Any substance or factor that can cause structural or functional malformations of an embryo or foetus (also known as congenital malformations or birth defects). Known teratogens include certain chemicals, viruses and ionizing radiation.

**Toxic substances:** Substances capable of causing harm to humans, animals or other living things. In common usage, the term refers to chemical substances that are capable of causing harm at very low levels of exposure; while providing little or no benefit.

**US EPA:** United States Environmental Protection Agency.

**US FDA:** United States Food and Drug Administration.

**UV Radiation:** Ultraviolet radiation emitted by the sun.

**VOCs:** Volatile organic compounds. Organic gases and vapours in the air. Examples of sources include the burning of fuels, dry cleaning operations, and the evaporation of organic compounds from solvents, paints, or other coatings. The 'typical' smell of glue, paint, air fresheners, new furniture, new carpets and many cleaning products is a sign that VOCs are being released. Common VOCs in indoor air include formaldehyde (carcinogenic), benzene, xylene, and toluene. VOCs 'off-gassing' from new paints will drop quickly but pressed wood and new carpets may emit VOCs for years.