# Human Impacts of Man–made Chemicals



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# INTRODUCTION

Our bodies have become repositories for dozens of toxic chemicals. It is thought that every person on Earth is now contaminated, and our bodies may contain up to 200 synthetic chemicals. Year after year, new chemicals are being added to the mix to which we are exposed. Scientists know virtually nothing about the long-term effects of many of these pollutants, especially when they act in combination with each other. Of those that have been studied in detail, many reveal links to an alarming array of diseases. Some commonly used synthetic chemicals are known to cause cancer, whilst others are suspected of causing adverse impacts on development in early life. Some have been linked to a variety of brain and nervous system problems and a number can cause fish to change sex. Many of these chemicals are found as pollutants in the food we eat, the air we breathe, and the clothes we wear. They are so widespread in consumer products and the environment that there is no escaping their pollution whether we want to or not.

In parallel with the continued rise in the manufacture and use of chemicals, a rise in the incidence of certain diseases has also occurred. For example, incidences of many forms of cancer are rising rapidly and certain diseases of the reproductive system are also on the increase worldwide. The ratio of male to female births appears to be shifting in some regions, as does the ratio of male to female foetal deaths.

The parallel rise of these phenomena could be a coincidence. The methods we have at our disposal to determine the causes of chronic diseases like cancer, or intergenerational impacts of chemicals that interfere with hormones, are too weak to give us clear answers. What is clear, however, is that many chemicals commonly found in the environment and in human bodies, have shown themselves in laboratory tests to be capable of causing the type of effects which may underlie the trends in human health that we are witnessing across the globe. We may never be certain that there are chemical causes behind these trends, but the evidence cannot be ignored. Research published in peer-reviewed scientific journals has reported possible links between commonly used chemicals and a range of health problems:

- testicular, ovarian and breast cancers
- falling fertility and collapsing sperm counts
- abnormal growth and development
- the feminisation of young boys and the masculinisation of girls
- significant shifts in the ratio of male to female babies
- impaired immunity
- brain and nervous system disorders.

The toxins that can produce these problems are by no means confined to industrial wastes. Many are used as chemical additives in a wide array of consumer goods, such as:

- food and drinks containers
- household cleaning products
- furniture
- shampoos, cosmetics and toiletries
- household and agricultural pesticides.

Others are generated as unintentional byproducts of industrial processes or waste management systems. As a result of their widespread production, use, and release, now and in the past, a variety of toxic chemicals can be found as contaminants in air and water near incinerators, landfill sites, power stations, steel works and other industrial facilities. They are also found as contaminants in foods such as meat, fish, eggs and milk.

We are now at a pivotal moment in history. The European Union (EU) is currently considering legislation that is designed to alter significantly the way chemicals are regulated and used across the EU. The

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proposed new regulations promise to bring certain chemicals under stricter control and compel industry to provide data to prove that they are safe and do not have an unacceptable impact on the environment. For the first time, the vast majority of the 30,000 to 70,000 chemicals in daily use will be scrutinised and their dangers assessed. More than that, the proposed legislation holds out the promise that today's most dangerous chemicals will begin to disappear from use in Europe altogether. The EU has identified a group of substances it classifies as 'chemicals of very high concern'. These are chemicals that build up in the human body and cause cancer, genetic damage, or affect the reproductive organs. Crucially, it also includes chemicals for which we have little or no understanding of how they might affect our bodies, but which once in the environment remain for long periods of time,

accumulating in the food chain and finding their way into our bodies.

This report provides further indications that we are urgently in need of laws that protect us from continued exposure to these 'chemicals of very high concern'. However, it is not yet clear that the new legislation will do this. Whether it does or not depends partly on whether European citizens demand that the chemical industry is brought under control, and particularly that those chemicals identified as of very high concern are refused a licence for continued production.

Ultimately, the European legislation may also have a positive impact world-wide. It is to be hoped that once the most dangerous chemicals have been identified and banned, other governments will follow the lead of the EU and phase them out.

# THE DAMAGE

#### **Declining sperm counts**

In many industrialised countries, male fertility has declined significantly over the past few decades. On average, a typical western man produces only about half the sperm that his father or grandfather did.<sup>12,3</sup> Studies in France, Scotland and Denmark have all shown that sperm quality is even worse in younger men.<sup>45,6,7,8,9</sup> For example, a recent study in Denmark showed that 18–20 year-olds born around 1980 had the lowest sperm counts ever recorded in normal Danish men.<sup>9</sup>

Professor Niels Skakkebaek, from the Copenhagen University Hospital, one of the most respected researchers in the field, says that "environmental or lifestyle factors" are the most likely causes of the collapse in male fertility.<sup>4</sup> Evidence is emerging that hormonedisrupting chemicals in the environment could be capable of such impacts. These chemicals mimic the body's own hormones and can throw its internal controls into disarray. Chemicals identified as having hormone-disrupting properties are found in some food and drinks containers, in soft furnishings, plastics, toys and children's clothes. In fact, they are so common that it is very difficult to avoid them, especially as their presence in products is very rarely labelled. Perhaps the most disturbing feature of these chemicals is that their greatest propensity for harm may be exerted at the most sensitive stages of human development - while a baby is still in its mother's womb and in the first years of life.

### **Disrupted development**

Embryonic development is often assumed to be controlled by a library of genes. In fact, it is more accurate to view the earliest stages of growth and development as an orchestra in which genes are just one instrument. Hormones are equally vital. Hormones are chemical messengers that shuttle information around the developing embryo, often switching genes on and off as they do so. It is a system of such phenomenal complexity that scientists are only now beginning to unravel it after decades of study. This hormonal, or endocrine, system is built around bodily checks and balances, feedback loops, and a host of other control mechanisms that together ensure the embryo develops normally. Anything that interrupts this flow of information – or corrupts it – can have devastating consequences.

At conception, an embryo has the potential to develop either male or female characteristics (regardless of whether it is genetically male or female). Exposing a genetically male embryo to a chemical that mimics female oestrogen hormones may harm the development of normal male sexual organs.<sup>4</sup> The reverse is true for genetically female embryos exposed to excessive amounts of the male hormone testosterone.

A large number of synthetic chemicals mimic human hormones. Bisphenol A (BPA), which is found in products made of the plastic polycarbonate, including many babies' bottles, is a known oestrogen mimic.<sup>10</sup> More than 40 published studies have now linked BPA to hormonal disturbances. Despite this, more than 450,000 tonnes of BPA were being produced and consumed worldwide every year by 1996.<sup>11</sup> BPA can be present in the inner linings of food cans, in the plastic trays of ready meals, and is used in some dental fillings. Worryingly, it has many of its effects at the same concentrations that we are all exposed to on a daily basis.<sup>12,13</sup>

A number of brominated flame retardants – used to fire proof soft furnishings, electronics and some clothing – also mimic oestrogen and can disrupt human development. A chemical variant of BPA, the flame retardant brominated-BPA, is also a known oestrogen mimic.<sup>14,15</sup> However, it is not just female sex hormones that are mimicked by industrial chemicals. Polychlorinated biphenyls (PCBs) can interfere with thyroid hormones and there are concerns that certain brominated flame retardants may be capable of doing the same.<sup>16,17</sup> Disrupting the action of thyroid hormone can have a massive impact on the development of the brain and nervous system.<sup>16</sup> Organotins – found in plastics, floor coverings and in the antibacterial coatings of clothes – can interfere with the metabolism of the male sex hormone testosterone.<sup>18</sup>

#### **Testicular cancer**

Endocrine-disrupting chemicals have been implicated as possible contributing factors in a number of diseases that afflict men and boys. At the same time, a number of worrying trends in male reproductive health have been identified. Incidence of testicular cancer, and possibly of undescended testis and hypospadias (where the urethra opens, not at the tip of the penis, but along the shaft or scrotum), have increased. Sperm quality is low and appears to be still falling across many parts of Europe and the USA.<sup>4</sup> The incidence of hypospadias doubled in the USA between 1970 and 1993.19 Testicular cancer has increased dramatically in some parts of the world and is now the most common form of cancer among young men in some countries.<sup>20,21</sup>

In 2001, a paper published in the prestigious journal Human Reproduction noted:

"The seriousness of these problems is highlighted by recent health statistics from Denmark, where reproductive diseases, including testis cancer, are still increasing. Almost 1% of (mostly young) men are treated for testicular cancer, 5–6% of schoolboys have undescended testis, almost 1% have penile abnormalities at birth and more than 40% of young adult men have subnormal sperm counts. There have also been concerns about a low and decreasing birth rate in many industrialized countries, where up to 4–5% of children today are born after assisted reproduction. The phenomenon is usually ascribed to lifestyle factors (e.g. increasing numbers of women in the workforce) but it remains to be investigated whether or not the decline in male reproductive health also contributes to the problem." <sup>4</sup>

So common and intertwined are the various diseases and abnormalities of men's reproductive systems that scientists are beginning to wonder whether they are, in fact, symptoms of a single disease.<sup>4</sup> This disease, called testicular dysgenesis syndrome (TDS), probably begins in the first weeks and months after conception and is likely to result from disturbances in the endocrine system.<sup>4</sup> While the causes remain unproven and may vary from case to case, increased exposure to endocrine disrupting chemicals cannot be ruled out as an important contributory factor.

# It's not raining men

Relative to girls, boys are dwindling in number.<sup>22,23,24</sup> In many industrialised countries a dramatic shift is occurring in the birth ratio of males to females. The USA 'lost' an estimated 38,000 boys between 1970 and 1990. A similar trend began around 1950 in the Netherlands and Denmark. Since then, the USA, Canada, Sweden, Germany, Norway, Japan, Finland, and Latin America have all seen dramatic shifts in the ratio of boys to girls (see Graphs1–3). In parts of Canada, nearly six boys per thousand are 'missing'. In some rural parts of the USA, three girls are born for every two boys.

#### Graph 1: Male/female ratio of foetal deaths compared with infant and neonatal deaths (after 12 weeks) in Japan (adapted from Ref. 25).



Although the causes are again uncertain, it must be recognised that anything capable of causing such population shifts may be having other, more subtle effects on the health and wellbeing of the human race. A paper in the *Journal of the American Medical Association* concluded:

"The reduction of the proportion of males born may be a sentinel health event that some, as yet unrecognised, environmental health hazards are affecting the sex ratio of births as well as other unexplained defects in male reproduction."<sup>23</sup>

So what is causing the disappearance of all these boys? Scientists are unsure but one theory is that synthetic chemicals are to blame. A paper in the *Canadian Medical Association Journal* warns that:

"Exposure to environmental toxins has been shown to alter the sex ratio of live births in both human populations and animal models... It is possible that certain biological markers such as sex ratio and semen quality are being altered by as yet unidentified factors that may include environmental toxins." <sup>22</sup>

It is possible, although not proven, that synthetic chemicals may be involved in the decline of the male birth rate by selectively killing male foetuses. Research published in the Lancet indicates that male foetuses are dying in unprecedented numbers in the first few months after conception, and they are doing so at ever-earlier stages of development.25 This could explain, at least in part, the disappearing boys. The Lancet recorded that in 1966, 2.52 male foetuses died for every female between the ages of 12-15 weeks. In 1986 this had risen to 6.16. By 1996, more than ten male foetuses were dying for every female. In total, throughout pregnancy, more than twice as many male foetuses are dying as females.

Graph 2: Proportion of male biths in Denmark and the Netherlands, 1950–1994 (adapted from Ref. 23).



Graph 3: Male proportion of newborns in Canada, 1970–1990 (adapted from Ref. 23).



There is no conclusive evidence that proves synthetic chemicals are to blame for this shift in the sex ratio, but an emerging pattern suggests that they could be the culprits. Studies in animals have shown that numerous synthetic chemicals shift sex ratios and can wreak havoc with the body's control systems, and that unborn children, particularly boys, are uniquely vulnerable. Scientists are unsure which chemicals, or combination of chemicals, are to blame.

# Chemicals of concern Alkylphenols

Alkylphenols – found in some plastics, food wraps, and DIY products – are known to cause oysters and zebra fish to change sex. These compounds are also known to alter the sex ratio of oysters.<sup>26</sup> They are potent endocrine disrupters and numerous studies numerous studies have shown that, once released to rivers and lakes, they are highly resistant to breakdown.

# Organotins

Organotins are known to affect the sexual organs of many species. They are found in plastics, textiles, and until recently were common in baking paper for cakes and biscuits. Some organotins are known to cause sterility in mussels and marine snails. They do this by blocking the enzyme that converts the male hormone testosterone to the female hormone oestrogen.<sup>18,27</sup> Crucially, the same effect is seen with the human version of the same enzyme, indicating the possibility that organotins have an equally profound impact on developing male embryos. Organotins have a significant effect on reproduction in rats, increasing the likelihood of miscarriage.28 Scientists now worry that organotins may have similarly dramatic and far-reaching effects on humans too.<sup>18</sup> They are also suspected of reducing sperm quality in mammals.27 Organotins are known to build up in the human body, especially in the liver.<sup>29</sup>

#### **Bisphenol A**

BPA, found primarily in products made from the plastic polycarbonate, is also known to have a huge impact on the developing foetuses of many species. It inflicts this damage at concentrations routinely found in pregnant women.<sup>12,13</sup> Given that BPA mimics female hormones it might be expected to preferentially damage developing male foetuses. The damage caused by BPA is both severe and wide-ranging. Rats and mice suffer metabolic, reproductive and behavioural abnormalities. It affects their growth rate and interferes with the growth of their testes, seminal vesicles, prostate glands, urethras and penises. As might be expected from this catalogue of defects, it also reduces their fertility. Female mice also suffer breast abnormalities and the chromosomes of their

developing eggs can be severely damaged by BPA. BPA also affects the maternal behaviour and metabolism of female rats and mice. It alters their timing of puberty and their menstrual cycles.

One particularly disturbing series of experiments has linked the kind of damage inflicted by BPA in rat embryos to a huge increase in aneuploidies – a specific type of mutation seen in many miscarried human babies. In rats, damage to the mechanisms of cell division was caused by astonishingly low levels of BPA, merely those levels released from damaged polycarbonate cages or water bottles.<sup>10,30</sup>

# Dioxins

Perhaps the strongest pointer towards synthetic chemicals having a role in modifying sex ratios comes from Seveso in Italy. In 1976, an industrial accident released large amounts of the highly toxic and persistent chemical dioxin into the environment. Over the following seven years, 48 girls were born and 26 boys. No sons were born to nine couples with the highest dioxin exposure.<sup>23</sup> Normally roughly equal numbers of girls and boys are expected. Clearly, dioxins at least, can cause a dramatic loss of boys. However, dioxins alone are unlikely to explain the changing sex ratios that appear to be occurring on a more widespread basis. Scientists are rushing to discover the other causes before it is too late. As the Journal of the American Medical Association noted: "The survival of the species depends on the ability of males and females to reproduce successfully." 23

# Unusual behaviour

Boys are not just 'disappearing' they are also taking on some of the behavioural characteristics of girls. And young girls, it seems, are taking on some of the qualities of boys in return. Scientists in the Netherlands have been monitoring the behaviour of primary school children in Rotterdam since the early 1990s.<sup>31</sup> They are trying to discover whether exposure to certain synthetic chemicals in the womb affects a child's subsequent health and mental well-being. So far they have discovered that exposure to PCBs and dioxins significantly affect the types of play youngsters engage in. PCBs are now banned but were used extensively in electronic equipment. Boys exposed to PCBs in the womb tend to engage in more feminine play. Girls exposed to PCBs become more masculine. Dioxin exposure leads to both girls and boys becoming more feminine.

Other scientists have linked PCB exposure to reduced intelligence. For example, American children exposed to slightly above average levels of PCBs in the womb were two years behind in their reading age by the time they were 11-years-old.<sup>32</sup>

However, it is not just PCBs and dioxins that have damaging effects on the brain. BPA causes permanent changes in the parts of the brain associated with Parkinson's disease.<sup>33</sup> It also makes mice more liable to become dependant on amphetamine drugs. Writing in the journal *Neuroscience*, the authors cautioned: "*Our findings warn that chronic exposure to BPA in females may predispose their children to the craving for and relapse of psychostimulants.*" <sup>33</sup>

#### Women's reproductive health

Many synthetic toxins are suspected of playing a role in the rising incidence of women's health and reproductive problems. Over the past 50 years, women in industrialised countries have experienced a rise in abnormalities of the reproductive system. More women are suffering from endometriosis, osteoporosis continues to be a problem, and girls are entering puberty earlier.

### Endometriosis

Endometriosis is a condition in which endometrial tissue, the tissue that normally lines the inside of the uterus, grows outside the uterus and attaches to other organs, usually in the pelvic cavity, such as the ovaries and fallopian tubes. This tissue is under normal hormonal control, and builds up, breaks down, and bleeds like the lining of the uterus. This internal bleeding into the pelvic or abdominal cavities, has no way of leaving the body, and leads to inflammation, pain and the formation of scar tissue. Endometrial tissue may also be found in the ovary where it can form cysts.

Endometriosis causes intense chronic pain. It is estimated that one in ten women in the USA suffer from the disease, forcing more than 100,000 to undergo hysterectomies each year.<sup>34</sup> A number of synthetic chemicals are known to increase its prevalence and severity. In monkeys, PCBs and dioxins cause the disease and make it worse in animals that already have it. Other research suggests that PCBs and dioxins could increase the risk of endometriosis in women. People are regularly exposed to dioxin levels significantly above those that are known to cause endometriosis in monkeys.<sup>34</sup>

### Precocious puberty

In some parts of the world, girls are hitting puberty far younger than in the past, sometimes starting sexual development several years earlier than normal. A study in 2001 of children immigrating to Europe from parts of Latin America and Asia found that some girls started developing breasts before the age of eight and began their periods before they were ten.<sup>35</sup> Although scientists are unsure why this shift is occurring, exposure to the insecticide DDT in early life prior to immigration is one possible cause; high levels of the DDT breakdown product, DDE, were found in the blood of three-quarters of immigrating children exhibiting early puberty. Although

DDT is banned in the developed world, many countries in the South and East continue to use it against malaria-carrying mosquitoes. DDT is rapidly transported worldwide and soon finds its way through the food chain to man. The pesticide is thought to have its effect because DDE mimics female oestrogen hormones. DDE, in combination with other oestrogen mimics, could trick a young girl's body into entering puberty early. It is not unreasonable to assume that other synthetic mimics may have similar effects.

#### Chemicals and cancer

Cancer is now the UK's biggest killer.<sup>36</sup> It has been rising remorselessly across the industrialised world since the 1950s. More than one in three people in England and Wales can expect to contract some form of cancer and it kills one in four.<sup>36</sup> Since the 1950s, deaths from most other major diseases have continuously fallen. One factor driving this rise is undoubtedly an ageing population.

However, some scientists estimate that environmental factors play a significant role in the development of a substantial proportion of cancers.<sup>37,38</sup> These factors are many and wide-ranging. Smoking and excessive alcohol consumption are known risks. Hereditary factors also play a part. However, when all these factors are stripped away, the environment still appears to be the single biggest cause of the massive increase in virtually all cancers seen over the past few decades. Since 1971 in England and Wales, prostate cancer has increased by 60%, skin cancer and non-Hodgkin's lymphoma by over 300%, and kidney cancer has almost doubled.37 Breast cancer in men has also rocketed.<sup>39</sup> These figures have been corrected to take account of an ageing population. The absolute increase in cancer is far higher.

Numerous synthetic chemicals are known to cause cancer, but amazingly there are no figures to show exactly how many. This is because the majority of all commonly used chemicals have never been adequately screened. Often when one of these substances is tested, the results paint an alarming picture. The International Agency for Cancer Research says that 56 pesticides are carcinogenic in lab animals.<sup>40</sup> Far fewer have been classified as to human carcinogenicity. Exposure to the weed killer MCPA, for example, has been linked to non-Hodgkin's lymphoma in humans. The incidence of this disease has increased by 300% since 1971 in England and Wales.

It is not just pesticides that are linked to cancer, a wide range of common pollutants are too. The most toxic dioxin, known as TCDD, is classed as a 'known human carcinogen'.<sup>41</sup> PCBs which, like dioxins, build-up through the food chain, are classed as 'probable human carcinogens'.<sup>42</sup>

Another group of potential carcinogens to which we are widely exposed is the brominated flame retardants. These are widely used in soft furnishings, foams and carpets. As well as being suspected cancercausing agents, the flame retardants affect the function of thyroid hormone and may cause behavioural changes in laboratory animals.43 They are now found in human blood, serum and fat.<sup>44</sup> When Greenpeace analysed house dust from over 100 homes across the UK, brominated flame retardants were found to be widespread contaminants.45 Exposure to contaminated dust in the home or at work could be an important contributor to the high levels of flame retardants discovered in people's bodies.

Workers may be continuously exposed to higher levels of these chemicals than the general population. Even so, we are all exposed to chemical hazards on an ongoing basis. Even chlorine in the water supply may carry a cancer risk – the risk of contracting rectal cancer doubles for those who drink chlorinated water for 40 years.<sup>46</sup> Bladder cancer too has been linked to chlorinated water.<sup>46</sup> Other chemicals, such as PCBs and organotins interfere with the immune system and so may increase cancer rates indirectly. Certain organotins, for example, inhibit the body's own tumour-killing cells by up to 90%.<sup>47</sup> They do this at levels only slightly above those found circulating in people's blood.

Some chemicals also help cancer to grow and spread. Such chemicals often mimic the hormone oestrogen and can accelerate the growth rate of certain cancers. Nonylphenol, found in paints, car cleaning products and PVC toys, and BPA, a component of polycarbonate plastics, are two such examples.<sup>48,49</sup>

# No escape

As with many synthetic chemicals, it is virtually impossible to escape PCBs and dioxins as we are exposed to them through air, food and water. Even though they ceased to be made almost everywhere after the 1970s, PCBs are still widespread in the environment, and are found in the body tissues of many species, including humans.

PCBs and dioxins persist in the environment and concentrate through the food chain. The current threat posed by PCBs has the potential to become even more serious. Only about one third of the PCBs manufactured have so far leached into the environment. The remainder is believed to be in old electrical equipment or in waste dumps. PCBs will continue to menace the human race for generations to come.

### Bioaccumulation

Like dioxins and PCBs, several brominated flame retardants, BPA, organotins, alkylphenols and a host of other synthetic chemicals can accumulate through the food chain, even if they are initially dispersed widely throughout the environment. PCBs in Lake Ontario are magnified 25 million-fold through the food-chain. That is, the animals at the top of the food chain contain 25 million times as much PCB contamination as the surrounding environment.<sup>50</sup> This vast accumulation (or bioaccumulation) occurs because these pollutants have two crucial factors in common: they are very stable and they dissolve in body fat.

The first step in the food-chain in the ocean, for example, begins when tiny plants, or phytoplankton, absorb the synthetic chemicals. These phytoplankton are then eaten by tiny animals known as zooplankton. The persistent poisons then pass into the fat of their new hosts and begin to accumulate. When these zooplankton are eaten in their thousands by larger creatures, the poisons are passed on and become yet more concentrated. These in turn are consumed by small fish, which are then eaten by larger fish. Larger predators, such as herring gulls or humans, then eat the larger fish. At each step, the toxins are concentrated in the creature's body fat ready to be eaten by the next animal in the food chain. Because the pollutants are stable, they tend not to be broken down efficiently in the environment or in body tissues. Humans are at the top of many different food chains, and as a result are exceptionally vulnerable. The human baby, one step higher up the chain than the mother, and even more vulnerable, can suffer the highest doses of all.

Our diets have become enriched with a wide assortment of toxic pollutants. In the UK, 37% of toddlers exceed the upper value of the Government's recommended maximum tolerable daily intake.<sup>51</sup> Although these levels are set with adults in mind, unborn babies, infants, and children are even more vulnerable to the buildup of synthetic chemicals. Their developing brains, bodies, and reproductive systems are far more sensitive than those of adults. They also come into contact with proportionately far more pollution: relative to their size, youngsters breathe twice as much air, eat up to four times as much food, and drink up to seven times as much water as adults. They also tend to ingest far more house dust and dirt, which often contains elevated levels of carcinogens, hormone disrupting chemicals and mutagens, which probably originate from such seemingly innocuous items as carpets, furnishings and cleaning products.<sup>45</sup>

#### **Global pollution**

It is not just those close to the source of contamination that suffer. The nature of many persistent synthetic chemicals means they are often transported worldwide. Many of them appear to be accumulating in formerly pristine environments such as the far north of Canada and the Antarctic. The most likely explanation is that the pollutants evaporate into the atmosphere and are then transported on air currents to the cold Polar Regions where they condense. In effect the world's atmosphere acts as a giant distillation apparatus that concentrates toxic pollution in the planet's most unspoilt wildernesses - and in some of its most beautiful creatures. Synthetic pollution is now regularly detected at high levels in seals, polar bears and whales. But it is not just the world's most isolated regions that are at risk from this pollution. European rainwater is now so contaminated with dissolved pesticides that levels regularly exceed standards set for drinking water.52

#### Shaken and stirred

Our bodies contain a cocktail of poisons, carcinogens, mutagens and hormonedisrupting chemicals.<sup>53</sup> Individually they may be present only at low levels. Evidence is emerging, however, that many of these chemicals add to and re-enforce each other's negative effects. <sup>54</sup> When it comes to the end result, the whole can be greater than the sum of the parts. This so-called 'cocktail effect' could explain the remorseless rise in cancers and other 'diseases of affluence' that plague the industrialised world. And it is beginning to alarm scientists.

A recent review of the state of scientific knowledge on endocrine disrupting chemicals concluded that, although uncertainties remain substantial, the available evidence raises serious concerns for scientists and public officials.<sup>22</sup> The authors stress that, despite the uncertainties:

"...it would be derelict to ignore the increasing evidence coming from these experimental studies, the naturally occurring malformations and behavioural problems found in chemically-exposed wildlife, and the increasing incidence of comparable malformations and behavioural problems in human populations that are exposed to the same chemicals during different developmental stages."

#### They go on to conclude that:

"All of this evidence should be sufficient to encourage us all to apply the precautionary principle and thus ban or substitute those chemicals that are likely to be harmful to the normal development of humans and wildlife".

# CONCLUSION

The last 50 years has seen an enormous increase in the production and use of chemicals. This has led to an increased number of man-made substances finding their way into the environment, not just from industrial chimneys and effluent pipes, but also from products commonly used in the home. As a result we all now carry a mixture of many different chemicals in our bodies.

Of those chemical pollutants found in human tissue, a significant number have been shown to lead to effects on the health of various different animal species, including mammals. These effects include cancer, deformities of the reproductive system, weakened immunity and behavioral disorders. Over the same period the incidence of some of these diseases in humans, including cancer and reproductive system disorders, has increased dramatically.

It is not possible with the scientific tools currently available, to know to what extent chemical pollutants are responsible for the increase in these diseases. As well as increased exposure to a greater number of chemicals, there have been other changes over the last 50 years. For example, changes in diet and lifestyle could be having an influence, and it is impossible to separate possible effects of these 'confounding factors' from effects of chemical exposure. This uncertainty about cause and effect is currently used by politicians as a reason to avoid taking action to protect people from chemical exposure. Chemicals are used in all sorts of ways and are allowed to accumulate in our bodies, because direct proof of damage to human beings is not available. This is upside down logic. We should not wait for proof that chemicals have harmed people before taking action on substances whose intrinsic properties give cause for high concern.

However, there are now moves afoot to bring chemicals under control. In 2001 the EU proposed legislation that would reverse the burden of proof (a chemical would have to be shown to be safe before it could be made) and make sure the world's most hazardous chemicals were phased out and replaced with safer alternatives.

It now appears as though that promise will be broken. This report highlights some of the reasons why it must not be broken. Because the chemical industry is using its economic might to persuade the EU to allow it to continue exposing us all to toxic, persistent and bioaccumulative chemicals, EU citizens must fight for their right to an environment free of these most hazardous of chemicals.

Visit www.greenpeace.org.uk/toxics to find out how.

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