DO SYNTHETIC CHEMICALS IN OUR ENVIRONMENT THREATEN OUR FUTURE?

By
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A recent controversial look at the health effects of environmental chemical pollution attracted much attention - 'Our Stolen Future' by Theo Colburn, J.P. Myers and D. Dumanoski (Little Brown and Co. 1996). The authors argue that the world is everywhere polluted with long-lasting chemicals that mimic human hormones and that have insidious and serious effects, mainly on the human reproduction system. For example, recent studies report that male sperm counts have declined by 50% over the last 50 years. In other words, the future of the human species may be compromised. However, the evidence, although indicative, falls well short of proving the case, and the authors admit this. Nevertheless, the argument is strong enough to merit serious investigation.

Hormones are natural chemicals in the body that regulate growth, body chemistry, reproduction, and the functioning of various organs. They are secreted in minute concentration (parts per million) into the bloodstream by various glands and they travel to their tissue destinations where they exert their effects.

For example the thyroid gland, in the neck, secretes a hormone called thyroxine, which regulates our general rate of body metabolism and also has a profound effect on the rate of development from the infantile into the adult form. The main male sex hormone is testosterone (produced in the testes), and the main female sex hormone is estradiol (produced in the ovaries). Both are important in controlling sexual development and characteristics. A deficiency or excess of any of the hormones upsets the chemical equilibrium of the body and can play havoc with normal development and with general health.

Since 1940 the world has seen an explosion of synthetic chemical use - plastics, herbicides, insecticides, wood preservatives, paints, etc. In 1992, 800 billion kg of carbon-based synthetic chemicals were manufactured globally. There are about 100,000 synthetic chemicals on the market and 1,000 new ones are introduced each year. Five kg of pesticides are used per capita, per year, in the USA.

Before a synthetic chemical is released to the public market it is tested for possible effects on human health. Prior to the 1940s these tests concentrated on acute poisonous effects - does exposure to the chemical make you ill, or kill you? Since the 1940s, the safety tests have concentrated almost exclusively on the potential of chemicals to cause cancer in those exposed to them, and birth defects in babies born to exposed mothers. This is fine as far as it goes, but, according to this book, it doesn't go far enough. The authors claim that many synthetic chemicals mimic natural hormone action and can therefore interfere with normal hormonal regulation of the body. New synthetic chemicals are not checked for this effect.

The authors describe the work of biologist Frederick von Saal to illustrate the exquisite sensitivity of living organisms, especially during development, even to the tiniest variation in natural hormone levels. Von Saal correlated the adult behaviour and characteristics of individual male and female mice, from the same litter, with the physical location they had in the mother's womb. About 1 in 6 female mice are carried in the womb, sandwiched between 2 brothers. These females are thus exposed to more male testosterone during development than sisters who lie between sisters, but only about 1 part per billion more. Von Saal noted that such females as

adults behaved more aggressively than their sisters, came into puberty later, had less heat and were less attractive to males. Similarly, males carried in the womb between females developed somewhat differently to males carried between males.

Problems associated with ingestion of synthetic chemicals that have hormone-mimicing action are well illustrated by the diethylstilbesterol (DES) story. DES acts like estrogen (female sex hormone) and was synthesised in the laboratory in 1938. It was administered to women in a widespread fashion, mainly to treat problems in pregnancy. No birth defects were noticed following its use, and, anyway, it was believed that chemicals ingested by the mother did not cross the placental barrier to the fetus. However, years later, problems were noticed during the development of children of mothers who had taken DES. Girls were more prone to develop vaginal cancer. It was also reported that boys had reproductive problems - abnormal sperm, undescended testicles - but the evidence is not conclusive here.

The experience with DES showed that the body can mistake a synthetic chemical for a hormone. The insecticide DDT also mimics female sex hormones when ingested. Of 51 synthetic chemicals that are loose in the environment, and that are known hormone disrupters, over half are long-lived, i.e. do not readily break down to harmless chemicals in the environment. One of the best known is a family called the polychlorinated biphenyls (PCBs). These were synthesised in 1929 and put into widespread use as coolants in the electrical industry, additives to plastics, etc. Their production was banned in most western countries in the 1970s. However, prior to that and subsequent to that, spillages and leaks released them to the environment, and being long-lived, they remain in the food chain.

Other known hormone disrupters are nonylphenol, dioxins and phthalates. Nonylphenol is added to polystyrene and plastics to make them stable and pliable. Industrial detergents also contain chemicals that can break down to nonylphenol. Nonylphenol can leach in low concentrations from plastics and has been shown to be an estrogen-mimic. Dioxin is another long-lasting chemical that is generated by burning certain plastics and fossil fuels. Phthalates are used in plastics, paints, inks and adhesives. In 1996 BBC Radio reported that leading brands of baby milk powder were contaminated with levels of phthalate that have been shown in animal experiments to interfere with male sexual development

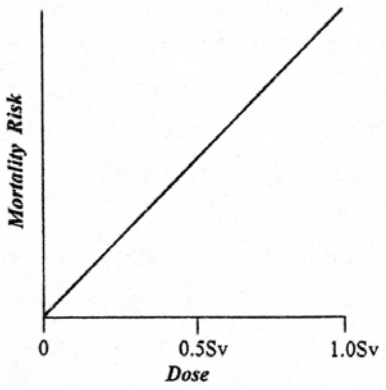
We have been ingesting these chemicals from the food chain at low levels for a long time. According to the authors, most peoples blood contains PCBs, DDT, dioxins, etc. at a concentration of parts per billion or parts per trillion. Are such levels sufficiently high to affect the developing fetus in the mothers womb? Also, many of these chemicals concentrate in body fat and the authors claim that they are secreted in a more concentrated form in mothers milk. Will nursing mothers pass on a problem to the infant? Experiments with animals indicate that feeding very low levels of some of these chemicals to pregnant rats at a critical stage can produce offspring with damaged reproduction systems. The big question in the book is - have we compromised the reproductive future of our children?

These chemicals have been in the environment for 50 years. If they have any effect one would predict that it would be transgenerational and mainly affect sexual reproductive function. Is there any evidence for such effects? The authors cite various studies to illustrate that such evidence does exist. Three studies have shown a decline in sperm counts by up to 50% over the last 50 years. Testicular cancer rates have increased (e.g. a three-fold increase in Denmark) over the same period, and there are reports of increased rates of undescended testicles in England and

Wales for the period 1962-82. In women, rates of ectopic pregnancies are increased. Also since 1940, rates of breast cancer have increased by 1% per year. As a general principle, risk of breast cancer is linked to lifelong exposure to estrogen.

So what do we make of all this? First of all, there is no need to panic. The evidence in this matter is far from conclusive. This is clear from the book, even though the authors naturally have a vested interest in making their case as plausibly as possible. I therefore conclude that the real strength of the case is considerably less than it seems. For example, studies that fail to find a link between naturally occurring levels of hormone-mimicking chemicals and health effects are not emphasised. Also, demonstrating an effect in an experimental animal does not necessarily mean that the same thing applies in humans. The human sperm count data is worrying, but other studies have found no decline in sperm counts.

However, the evidence is sufficiently strong to take serious notice. From now on synthetic chemicals should be tested for their hormone-mimicking capacity. Intensive study should be carried out to further test the hypothesis put forward in this book. If the hypothesis holds up, serious measures would be justified such as strictly controlling female diet until the time of the menopause. In the meantime, the extra stress caused by worrying about the matter in the absence of firmer evidence, could well cause more harm than any effects the chemicals might have.



Relationship between mortality risk and radiation dose.

Linear relationship between risk of death and ionising radiation. Risk is reduced to zero only at zero dose.

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