Low levels of persistent organic pollutants raise concerns for future generations

G M Solomon, A M Huddle

Bans and regulation in many countries have reduced the environmental levels of many persistent organic pollutants (POPs). Despite these declines, there is still evidence of exposures in a range associated with adverse health effects. This seeming paradox is a result of the realisation that levels once presumed safe can cause subtle but important health effects. For example, levels of PCBs now shown to affect human brain development are nearly one million-fold lower than levels previously believed safe. These findings add urgency to efforts to globally eliminate these chemicals, and carry lessons for persistent pollutants that are still in widespread use today, such as the polybrominated diphenyl ethers (PBDEs) and synthetic musks.

Schafer and Kegley show that persistent organic pollutants (POPs) banned in the United States decades ago are still a problem in the nation’s food supply. Others, however, have pointed out that bans and strict regulation of many POPs are clearly associated with decreasing concentrations of these chemicals in breast milk samples in many parts of the world (see fig 1). It initially seems a paradox that dramatic decreases in these contaminants have not eliminated the spectre of adverse health effects. The roots of this paradox are worth exploring because they offer historical lessons that we would do well to learn.

Although the POPs have a range of toxic properties, there is a recurrent historical pattern that characterises the science around many of these chemicals. In the example of the polychlorinated biphenyls (PCBs), initial small studies in adult male workers, exposed at high levels, did not demonstrate many dramatic health effects. Poisoning was associated with an acne-like syndrome, and some liver function abnormalities were noted, but the chemicals were initially touted as relatively non-toxic. Because of the apparent low toxicity, the fact that these chemicals were persistent and accumulated in fat was not considered of great concern. Few people at the time heeded Rachel Carson’s admonition that: “This pollution is for the most part irrecoverable;...it is now estimated to be about 0.0001 mg/kg/day.

The levels currently known to cause impairment in the human fetus are about a million times lower than the levels initially thought to be a concern based on toxicity to the fetus in the rat.

PCBs are not the only persistent pollutants showing an historical pattern of toxicity at lower and lower doses as studies gradually hone in on the relevant health effects and populations at risk. The nearly 20 year saga of the US Environmental Protection Agency (EPA) reassessment of dioxin repeats the same messages. Over time, the levels of concern became ever lower until finally EPA admitted that there was no apparent threshold for even the non-cancer effects of dioxin, with risks at every exposure level, even below the range of prevalent exposures in our society today. In the case of dieldrin, recent major cohort studies on breast cancer in Denmark have revealed links between increased risk of breast cancer and dieldrin residues in a woman’s fat. Women with slightly higher levels of dieldrin in their fat who do get breast cancer are also at higher risk of having a more aggressive tumour and of dying from the disease. These relatively new research findings come far too late to prevent the widespread exposure to dieldrin that exists today.

**Abbreviations:** POPs, persistent organic pollutants; PBDEs, polybrominated diphenyl ethers; PCBs, polychlorinated biphenyls
The history of ever lower levels of concern for many persistent toxic chemicals has created a compelling case for prevention. Many scientists and advocates have pointed out that waiting for clear evidence of harm in human populations is tantamount to closing the proverbial barn door long after the animals have scattered far and wide. If we fail to identify chemicals in use today that are likely to be the PCBs, dioxins, and dieldrins of the future, then future generations may be faced with evidence that the nutritious food they eat may be tainted by health risks.

Some current examples that demand our immediate attention include the brominated flame retardants and the synthetic musks. The polybrominated diphenyl ethers (PBDEs) are used as flame retardants in plastics, polyurethane foams, and textiles. Global production of these chemicals is approximately 40,000 tons per year. The chemical structure of the PBDEs is similar to the non-coplanar PCBs. The PBDEs are environmentally persistent and bioaccumulate rapidly. Levels of the PBDEs have doubled every five years in breast milk samples from Sweden (see fig 2), and residues of these chemicals have been detected globally including in the Arctic, samples from Sweden (see fig 2), and residues of these chemicals, they may have immunotoxic properties similar to the PBDEs.11

The synthetic musks (including the nitro musks and polycyclic musks) are also in widespread use as fragrances in personal care products and cleaning products. They are produced at over 7000 tons per year.12 Although there is little information on health effects from these chemicals, they are environmentally persistent, have been detected in sediment and fish samples from many regions, and have been reported in human blood and breast milk samples.13 14 There is no question that it will take years for adequate prospective epidemiological studies to investigate whether these new POPs are causing health effects in humans. Meanwhile, if there is no regulatory action, the levels of these chemicals will continue to increase in the environment, in our food supply, and in maternal milk.

It is time to take a positive lesson from chemicals such as the PCBs, DDT, and dieldrin: although they do persist in the environment, bans and strict regulation have resulted in clearly quantifiable decreases in human exposure over time. Instead of expending our efforts debating the exact risks from these new POPs, we should direct our efforts toward eliminating all chemicals that are persistent, lipophilic, and bioaccumulative from production worldwide.

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**REFERENCES**


