Public Health Concerns About Environmental Polychlorinated Biphenyls (PCBs)

By ACSH Staff — January 1, 1997

Polychlorinated biphenyls, or PCBs, are a family of more than 200 chemical compounds (congeners), each of which consists of two benzene rings and one to ten chlorine atoms. They were widely used in a variety of industrial applications due to their insulating and fire retardant properties. Concern about the presence of PCBs in the environment began in the 1960s, when PCBs were found in soil and water. Research confirmed that some PCB congeners degrade very slowly in the environment, and can build up in the food chain. In 1968, a widespread human poisoning episode in Western Japan (called "Yusho," or "oil disease"), was at first attributed to the consumption of rice bran oil contaminated with PCBs. Although subsequent analysis showed the presence of toxic thermal degradation products in the oil, which are now believed to have been responsible for the observed health effects, the Yusho incident and a similar incident in Taiwan ("Yu-Cheng") increased concern over the safety of PCBs. In the 1970s, commercial production of PCBs in the United States was restricted, and ended in 1979.

PCBs do not cause acute health effects in animals, except at extremely high doses. However, they have been shown to cause tumors in animals. Several regulatory and advisory agencies, including the U.S. Environmental Protection Agency (EPA) have determined that there is sufficient evidence to consider PCBs to be animal carcinogens. However, studies of workers exposed by inhalation
and skin contact to high doses of PCBs over long periods of time have not demonstrated an increased risk of cancer. In fact, skin and eye irritation were the only health effects in the workers that could be attributed to PCBs.

In the Japan and Taiwan episodes mentioned above, consumption of PCB-contaminated rice bran oil resulted in a severe form of acne called chloracne, fatigue, nausea, and liver disorders. There was also an increase in liver cancer mortality in the Yusho incident, and an increase in mortality from other liver diseases in the Yu-Cheng incident. The levels of PCB in the blood of workers exposed to PCBs exceeded those of the Yusho and Yu-Cheng victims, yet the extent of toxicity was far greater in the Yusho and Yu-Cheng victims. This is believed to be due to the presence in the rice bran oil of substances generated from the thermal breakdown of PCBs. These substances, furans (similar to dioxins) and quaterphenyls, are far more toxic than PCBs.

Studies of people who ate PCB-contaminated fish showed that, while the quantity of fish consumed was correlated with PCB blood levels, there were no significant health differences between those who consumed a lot of fish and those with lower exposures. A 1996 study suggested that prenatal exposure to PCBs from maternal ingestion of contaminated fish is associated with neurodevelopmental effects in infants and children. However, this is inconsistent with studies that have found no relationship between maternal PCB exposure and infant birth weight or head circumference. Problems with study methodology, specifically, exposure assessment and selection of the control (comparison) group, further limit the interpretation of the 1996 study results. Furthermore, as the concentrations of PCBs in the maternal blood were only slightly greater than in the blood of subjects who did not report eating fish (and were within the range of PCB blood concentrations for North America), we should be witnessing a widespread phenomenon throughout North America if PCBs could indeed cause intellectual impairment in children. There is no evidence of widespread intellectual impairment among children; thus, warning parents is not warranted at this time.

It has been suggested that chemicals such as PCBs in the environment can mimic the body's natural hormones (e.g., estrogen), and that this "endocrine (hormone) disruption" can lead to infertility, certain types of cancer, and other hormone-related disorders. However, the evidence for the estrogenic effects of environmental PCBs on either wildlife or humans remains weak and circumstantial, and premature conclusions have been drawn based upon inadequate and incomplete evidence. Numerous researchers have characterized the hypothesis that environmental estrogens cause increased breast cancer or male reproductive problems as unproven and implausible.

In summary, there is no conclusive evidence that background PCB levels in the general population, or even the very high levels to which some occupational groups were exposed, have resulted in acute effects, increased cancer risk, "endocrine disruption," or widespread intellectual deterioration in children exposed to PCBs \textit{in utero}. In fact, even those effects noted in PCB-exposed populations, e.g., chloracne, cannot be definitively linked to PCBs because of simultaneous exposure to other, known toxic agents, such as furans and quaterphenyls.

It is important to recognize that commercial and environmental PCBs consist of mixtures of individual PCB congeners. These congeners vary in their degree of toxicity, and the toxicity of any
mixture is dependent upon the toxicity of the individual congeners. Laboratory studies of PCBs are, for the most part, conducted on the commercial product; however, environmentally degraded PCBs to which people may be exposed can differ in their composition and toxicity from the original commercial PCB mixture. Regulatory agencies are beginning to acknowledge this as an important factor in evaluating risk from exposure to PCBs in the environment.

Because of the ban on PCB production, decreasing use of PCBs, and efforts to remediate contaminated sites, general population exposure to PCBs in fish and other foods has been significantly reduced, and PCB levels in human blood are also decreasing. Industry and government should focus on the development of novel and cost-effective remediation and disposal techniques, as well as on scientifically improved health risk analysis to reduce the uncertainty associated with PCB exposure and health effects in humans.

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