Introduction

In 1985, the Great Lakes Water Quality Board identified persistent toxic pollutants as the principal issue confronting the Great Lakes, and developed a list of eleven “Critical Pollutants” deserving an early focus by remedial action programs. This newsletter continues the examination of recent medical literature on selected persistent organic pollutants from this list, including DDT, dieldrin, and hexachlorobenzene. Recent literature includes many studies for organochlorine manufacturing workers, reports of organochlorine residues in tissues of diseased and healthy persons, and morbidity studies among teratogenic-exposed animals. The emphasis on pollutants of the Great Lakes ecosystem is presented under the direction of the Health Professionals Task Force of the International Joint Commission. This newsletter does not represent the official position of the International Joint Commission.

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A quarterly summary of recent findings in the scientific literature on human health effects and environmental pollutants, with an emphasis on pollutants of the Great Lakes ecosystem. Prepared under the direction of the Health Professionals Task Force of the International Joint Commission. This newsletter does not represent the official position of the International Joint Commission.

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The Great Lakes Critical Pollutants

Organochlorine Residues in Normal and Diseased States

Investigators in Germany have carried out a series of studies to measure the levels of organochlorine pesticides (termed chlorinated hydrocarbons by these authors) in normal and diseased bone marrow, and in other tissues in normal and diseased states. All studies were conducted in Germany. In the first, the authors attempt to address the question whether these agents, many of which have mutagenic, carcinogenic or teratogenic effects in animals, contribute to pediatric tumors and malformations. They analyzed fat samples taken from 262 children and adolescents aged zero to 18 years. The samples were collected during operations required for other reasons. The children were divided into three groups: Group A, 183 healthy children (babies and children operated on primarily for congenital heart disease), including 12 neonates sampled before the first meal; Group B, 46 patients with malignant tumors (neuroblastoma, Wilms’ tumor, soft tissue sarcoma, and others); and Group C, 33 babies and children with congenital malformations or benign tumors (renal and urethral malformation, lipoma, lymphangoma and others). The specimens were analyzed for PCB’s, DDT metabolites, HCH isomers and cyclodienes. The results showed that alpha-, beta-, and gamma-HCH, dieldrin, p,p’-DDE, total PCB and certain PCB isomers variously were detected in either all or most samples. Heptachlor was detected in approximately half of samples. The highest levels were found for total PCB, DDT, HB and HCB isomers. Of the cyclodienes, only dieldrin was detected at significant levels. The concentrations of PCB, DDT, and HCB were highest in neonates who had not yet been fed, were significantly lower in infants six months old, and rose again to neonatal levels at the end of the first year of life. The concentrations changed little in the older childhood age groups. There were no significant differences in CHC concentrations between normal children and either babies with malignant tumors or babies with congenital malformations or benign tumors. The authors interpret the drop in concentrations between birth and six months to CHC distribution in the disproportionately increased body fat relative to non-fat tissue, and the apparent rise in the second half of the first year to the decrease in relative fat mass. The steady concentrations during the rest of childhood are interpreted as intake of CHC’s which corresponds to the increase in fat occurring with age. Noting the small sample size, the authors warn against using these negative results to conclude that there is no association between CHC levels and tumor or malformation in children. In another study, bone marrow from 35 children with leukemia (35 with ALL and 5 with CML) and 15 controls (9 children with ITP and 6 non-neoplastic bone marrow donors) were analyzed for the following compounds: alpha-HCH, beta-HCH, total HCH, dieldrin, HB, p,p’-DDE, p,p’-DDE, total DDT, PCB-138, PCB-153, PCB-180, total PCB, and total CHC. None of the CHC showed a normal distribution (as expected) with the median concentration for each agent being lower than the mean. There were no significant differences in concentrations of any of the compounds between children with and without leukemia.

Noting that the partitioning of chlorinated hydrocarbons (OC) and polychlorinated biphenyls is in part dependent on the fat content of tissues, the investigators then compared the concentrations of CHC and PCB in bone marrow with that of depot fat and breast milk. They found that for Beta-HCH, HCB, Total-DDT, PCB-138, -153 and -180, the highest concentration (in mg/kg fat), (most cases significantly), was in the bone marrow, compared to breast milk and fat tissue. They postulate selective partitioning into bone marrow. Note that the sources of the adipose tissue and breast fat (bone marrow, nursing mothers for breast milk).

Finally, bone marrow specimens obtained from 13 adults with hematologic malignancies (3 with AML, 3 with CML, 2 with chronic myelogenous leukemia, 1 with CLL, 1 with Hodgkin’s lymphoma, 1 with non-Hodgkin’s lymphoma, 4 with other hematologic malignancies) and 15 controls (9 children with ITP and 6 healthy adults) were analyzed for alpha-HCH, beta-HCH, total HCH, dieldrin, hexachlorobenzene, p,p’-DDE, and DDE. (as expected) with the median concentration for each agent being lower than the mean. There were no significant differences in concentrations of any of the compounds between children with and without leukemia.

Mortality Studies of Organochlorine Manufacturing Workers

(Continued on page 2)
An update of the mortality experience of workers at four different U.S. OC manufacturing plants, previously studied by NIOSH (Dritsiga, 1981), is presented. The purpose was to assess the risk of exposure to chlordane (plant 1); heptachlor and endrin (plant 2); aldrin, dieldrin and endrin (plant 3); and DDT (plant 4). SMRs were calculated for specific causes of death using national mortality rates as controls, and also, for plant (3 the Colorado cohort), state and regional controls. There were no exposure data available for this study, except for limited data on DDT among workers at plant 4. The results showed reduced overall mortality and reduced cause-specific mortality for all causes except cerebrovascular and respiratory disease in the four groups combined. A reduced overall mortality is commonly observed in occupational cohorts, consistent with the "healthy worker effect." This reflects the fact that to be a worker, one has to be relatively healthy, and the rate of cardiovascular mortality and thus overall mortality is usually lower in a working population than the general population.

Regarding cancer-specific mortality, there were excesses for stomach and hepatobiliary cancers in the groups combined; stomach cancer was non-significantly elevated in 3 of the 4 plants; and there was a significant increase in bladder cancer in one plant. In plant 3, there was a statistically significant increase in hepatobiliary cancer (5 observed, SMR 3.93, 95% CI 1.27-20). The five deaths included 4 from biliary tract, bile duct, or gall bladder; only one was a hepatoma. All hepatobiliary cancers occurred after at least 15 years of latency; there was no evidence of an exposure/response relationship (using duration of employment as a marker for exposure). The hepatobiliary SMR did not remain significant for all 4 plant combined. The authors note that the study is limited by the absence of exposure data.

A retrospective follow-up study reports the mortality experience of 2384 workers at the plant in Denver, Co. (the above mentioned "group 3") which produced organochlorine insecticides (aldrin, dieldrin, endrin); several organophosphates (azodrin, vapona); "group 3") which produced organochlorine insecticides (aldrin, dieldrin, endrin); several organophosphates (azodrin, vapona); and DDT (plant 4). Included were all white males employed for at least 6 months at the plants under study, from 1964 through 1987. SMRs were calculated for specific causes of death using national mortality rates as controls, and also, for plant (3 the Colorado cohort), state and regional controls. There were no exposure data available for this study, except for limited data on DDT among workers at plant 4. The results showed reduced overall mortality and reduced cause-specific mortality for all causes except cerebrovascular and respiratory disease in the four groups combined. A reduced overall mortality is commonly observed in occupational cohorts, consistent with the "healthy worker effect." This reflects the fact that to be a worker, one has to be relatively healthy, and the rate of cardiovascular mortality and thus overall mortality is usually lower in a working population than the general population.

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Conclusions

Demonstrating health effects in humans from chronic, low-level exposure to these persistent organic pollutants is a challenge for researchers. Effects may be subtle and their detection requires studying large populations. The potential long-term effects have implications for future generations, and thus should remain a priority for public health investigations.

Abbreviations used:

- ALL: acute lymphocytic leukemia
- AML: acute myeloid leukemia
- CHCl: chlorinated hydrocarbons
- CI: confidence interval
- CLL: chronic lymphocytic leukemia
- CML: chronic myelocytic leukemia
- DDE: dichlorodiphenyldichloroethylene
- DDT: dichlorodiphenyltrichloroethane
- DGL: D-glucaric acid
- HC: hexachlorobenzene
- HCH: hexachlorocyclohexane
- ITP: idiopathic thrombocytopenic purpura
- NIOSH: National Institute for Occupational Safety and Health
- OC: organochlorine
- PCB: polychlorinated biphenyls
- SCE: sister chromatid exchanges
- SMR: standardized mortality ratio

REFERENCES:


