GREAT LAKES HUMAN HEALTH STUDIES: NEUROBEHAVIORAL EFFECTS

GREAT LAKES HUMAN HEALTH EFFECTS RESEARCH PROGRAM STUDIES UNDERWAY

In May 1997, a conference was held in Montreal to discuss the findings of a series of studies on the human health effects of environmental exposures to pollution. Subsequent to the passage of the U.S. Great Lakes Critical Programs Act of 1990, the Agency for Toxic Substances and Disease Registry (ATSDR) has funded numerous research projects as a part of the Great Lakes Human Health Effects Research Program. In Canada, there are also a number of research studies on pollution-related health effects that have been conducted or funded by Health Canada. The Health Conference of May 1997 was cosponsored by both agencies, and it provided an opportunity for scientists and policy-makers to gather and discuss the findings of this new body of research.

The series of studies that are currently funded under the ATSDR’s program include epidemiological research, studies of exposure to environmental pollutants, and projects to improve analytical or quality control methods in environmental exposure assessment. Several existing cohorts, including the New York Sport Angler cohort and the Mohawk Indian cohort, are being utilized in studies of human exposure to persistent toxic chemicals. Several ATSDR-funded studies are assessing health effects of pollutants from environmental exposures, and these studies are described in more detail here. Additional studies have been funded to develop new methodology for toxicity assessment, and for developing quality control procedures for existing analytical methods. While this series of studies was highlighted in the recent conference, research projects are also being conducted or funded by numerous other agencies, and findings from a number of studies by Canadian researchers were presented. In the health studies, various effects are under study. Neurobehavioral changes are emphasized in this summary, because there is growing evidence that low-level exposures to contaminants can result in subtle endocrine or neurological changes that may lead to neurobehavioral impairment.

PRELIMINARY FINDINGS FROM GREAT LAKES HEALTH RESEARCH

A number of the ATSDR-funded studies will assess neurobehavioral effects in infants or older adults. The initial findings of the Oswego Newborn and Infant Development Project were published in 1996, and additional results were presented at the Montreal conference. This cohort includes approximately 150 mother-child pairs in each of three fish consumption categories. The first published report of neurobehavioral effects from this cohort uses the results of the Neonatal Behavioral Assessment Scale tests that were administered at 12-24 and 25-48 hours after birth. The change scores from these tests indicate that the high fish group babies demonstrated a greater number of abnormal reflexes and less mature autonomic response (e.g., more startles and tremors), and there was some evidence of less developed attention to visual and auditory stimuli. At the Health Conference, preliminary results of additional testing at age 24 months with an infant behavioral questionnaire were presented. Changes were found in overall and four of six behavioral scales in the assessment of infant temperament — activity level, fear, smiling and laughter, and sociaability — at higher levels of fish consumption, but the differences for individual scales lost statistical significance when controlling for demographic and other variables. Significant effects were seen in several behavioral categories on the Neonatal Behavioral Assessment Scale when analyzed by recency of fish consumption: habituation, orientation, autonomic and reflexes. The authors conclude that their findings generally support those of the Michigan study.3

The New York State Angler Study was initiated in 1991; during the recruitment phase, over 20,000 anglers and their wives or partners have responded to a questionnaire that includes information on reproductive and medical histories, and frequencies with which some foods are eaten. In a subsample of participants, blood, hair and urine samples have been collected to determine levels of lead, mercury and some PCBs. Additional studies planned include a study of the health of infants of cohort members, and the researchers are also collecting breast milk samples from lactating women for exposure studies. At the Health Conference, a research design for analyzing effects on the immune system were presented.6 Additional concern has been raised that older people may represent another population highly susceptible to the neurobehavioral dysfunction following exposure to environmental contaminants. Toxicological studies have found that PCB exposure is associated with decreased dopamine levels, and there is substantial loss (up to 60-70%) of dopamine-using nervous system cells in the normal aging process. A greater than normal loss of such cells may result in Parkinson’s disease and impaired cognitive function.

In a study of the Cognitive and Motor Effects of PCB Exposure in Older People from the Michigan Fishheater Cohort,7 Illinois researchers recruited 572 fish eaters (24+ years) and 419 nonfish eaters from the members of the cohort established previously by the Michigan Department of Public Health who are now at least 50 years of age. Blood samples were drawn to determine levels of PCBs, DDE and 10 other contaminants in 180 of the subjects. Questionnaires were administered to obtain demographic and fish consumption data. A two-hour battery of tests of motor function, memory and learning, executive functions, and visual-spatial functions was administered. PCB levels were found to be higher in the fish eater group, and higher levels were also found of lead and mercury, though the levels were low in both groups. Results from the fine motor function tests were presented at the Health Conference. High exposure to PCBs/DDE was associated with decreased performance on fine motor function tests, but the associations were not significant when adjusted for demographic and other correlated factors.7

In the study of Great Lakes Fish as a Source of Maternal and Fetal Exposure to Chlorinated Hydrocarbons,8 Illinois researchers recruited approximately 80 pregnant African-American women from the Chicago area, and the cohort was divided into subgroups that consume sport-caught fish, store-purchased fish, and no fish; many also consume wild fowl and game. Upon delivery, sample of maternal and cord blood, placenta, infant meconium, adipose tissue (if cesarean) and breast milk (where available) were collected. Future studies will include measurements of behavioral, endocrinological, and immunological function in the children.

Wisconsin researchers are conducting the Ojibwa Health Study9 in (Continued on page 2)
OBSERVATIONS FROM STUDIES OF WILDLIFE

Scientists studying wildlife populations were first to draw attention to the potential effects of environmental pollutants. While still few studies have been conducted on human health effects from these exposures, a larger body of literature is available from wildlife studies. These reports have provided evidence for more gross developmental effects than the subtle neurobehavioral changes reported in the U.S. and Canadian studies.

In one recent report, a group of researchers from the U.S. and Canada measured chick deformity rates in over 44,000 birds. In a recent commentary, researchers in Taiwan observed that results from laboratory research are not always considered in the overall body of literature regarding neurobehavioral effects of PCBs. She notes that, in these studies, PCB-exposed animals appear to have difficulty in changing response strategies and/or inhibiting inappropriate responses, which is consistent with the findings from the epidemiological studies. *Paneth et al.* (9) observes the cautionary note of determining the extent to which decreased performance on a standardized test, obtained under natural conditions, was associated with postnatal PCB exposure measures, but still few human studies considered these exposures to be associated with these exposures, but the associations were not significant when prenatal exposure measures included in the model. Finally, the Yu-Cheng population represents an older cohort of persons exposed to PCBs and other organochlorine contaminants in rice oil used for cooking; developmental effects have been reported in the children born to Yu-Cheng women. Previous studies of the Yu-Cheng have found little or no correlation between levels of PCBs and the effects observed. In a recent commentary, researchers in Taiwan reported on the initiation of new studies to better define the exposures of Yu-Cheng patients and children. Recent developments in analytical methodology have greatly increased scientists' ability to determine levels of individual organochlorine pollutants in human serum or tissue. The new studies will provide new insight on whether the PCBs, PCDFs or PCDDs are the causative agent of the Yu-Cheng health effects.REFERENCES:

1) DeRosa CT, Johnson BL. 1996. Toxicol Ind Health 12:315-325