Susceptibility of the Fetus and Child to Chemical Pollutants

As chemicals increasingly permeate our environment, there is a need to consider the special vulnerability of the fetus and child. As a first step, a meeting was held on this subject at Browns Lake, Wisconsin, 11 to 13 June 1973, under the sponsorship of the Committee on Environmental Hazards of the American Academy of Pediatrics, the National Institute of Environmental Health Sciences (NIEHS), and the National Institute of Child Health and Human Development (NICHD). Fresh thinking was sought by bringing together scientists who know about environmental effects but not about child health, and pediatricians, who know about child health, but have not given much thought to environmental effects.

Children may be harmed in special ways by pollutants, as illustrated by two epidemics in Japan: the well-known occurrence of congenital cerebral palsy among infants whose mothers, during pregnancy, ingested fish contaminated with methylmercury from industrial waste, and the less well known occurrence of undersized newborn infants with brown discoloration of the skin caused by maternal ingestion of polychlorinated biphenyls which leaked into cooking oil as it was manufactured.

The history of medicine reveals that environmental causes of malformations and other diseases in man have usually been first recognized by alert practitioners. With this in mind, the participants repeatedly urged implementation of an Alert Practitioner Program, in which physicians would report suspicions of new environmental effects for evaluation by a panel of experts. A feasibility study concerning childhood diseases is being made by the American Academy of Pediatrics under contract with NIEHS.

When population studies are contemplated, Sullivan (Guy's Hospital, London) noted that if the usual frequency of an anomaly is 1 in 1,000 newborn infants, the offspring of 23,000 mothers who had taken a suspect drug must be studied to detect a doubling in the incidence of the defect. Other participants stressed the desirability of monitoring populations for the earliest possible detection of malformations due to chemicals newly introduced into the environment.

In screening for transplacental hazards, Fraumeni (National Cancer Institute, Bethesda), stated that the entire range of fetal response should be covered, including miscarriage in the early stages, malformations during organ development, and neoplasia when exposure occurs later in pregnancy. Battaglia (University of Colorado) stated that chemical pollutants might also affect the rates for premature births. The onset of labor is in part triggered by the pituitary-adrenal axis of the fetus and by enzyme systems affecting the synthesis of prostaglandins in the uterine mucosa. Chemicals might affect prematurity rates by blocking enzymes that channel certain fatty acids to prostaglandins. An increase in the prematurity rates of California sea lions has since been attributed to organochlorine pesticides and polychlorinated biphenyl residues.

The effects of interacting environmental chemicals was illustrated by the increased frequency and severity of cretinism on Idjwi Island in the Congo. The increase, as described by Gardner (State University of New York Upstate Medical Center), was due to a deficiency of iodine in the diet, the adverse effects of which were worsened by eating cassava. Linamarin, a glucoside in this food, produces cyanide, which, when metabolized to thiocyanate, depresses iodine uptake by the thyroid.

The brain may be particularly susceptible to environmental exposures, but minimal dysfunction is difficult to demonstrate. Weiss (University of Rochester) stated that techniques must be developed to evaluate the relative contribution of various components of the brain, as well as the relationship among all of the structural, functional, and chemical constituents of the central nervous system.

Important concepts about general principles of teratogenesis have come from animal experimentation, but such studies have not been satisfactory in predicting the effects of drugs in man. As an example of new understanding which can be derived from molecular biology, Dorfman (University of Chicago) described the importance of timing in cell differentiation. When 5-bromodeoxyuridine (BrdU) is substituted for thymidine in DNA early in the development of cells in culture, the cells will not differentiate. If BrdU is introduced after differentiation, the cells will not perform certain functions: muscle cells will not make myosin, and cartilage cells will not make chondroitin sulfate. By such studies a basis may be

established for the different actions of teratogens at different stages of development.

In turning from the fetus to the child, Brown (University of Georgia) said that recent research into bilirubin metabolism gives added importance to the effects of light soon after birth. In the newborn infant, bilirubin absorbs light, which may then react to form singlet oxygen and be degraded into water-soluble dipyrroles. Infants should be observed for the effects of actions consciously sought from a drug and unconsciously produced from sunlight or fluorescent bulbs.

More is known about air pollution. Holland (St. Thomas' Hospital, London) presented evidence that the origins of respiratory diseases with onset late in life can be traced to childhood: persons who migrate from one country to another, even before 10 years of age, carry with them the higher disease rate of the old country. The next generation, born in the new country, does not have its parents' higher rate of respiratory diseases.

Other potential hazards in the environment of the infant or child include skin preparations (such as hexachlorophene), dyes or other materials on the surfaces of toys, pesticides and herbicides, and, as always, lead poisoning from ingesting paint from the walls of deteriorated old houses.

The teen-ager, because of unusual social and environmental subcultures, may experience special environmental difficulties. Cohen (Montefiore Hospital, New York) noted that food faddism and drug abuse, so common among adolescents, pose a variety of problems which may be intensified by the active growth of members of this age group. Adolescents are also more prone than older persons to enter occupations which subject them to chemical hazards.

In reviewing the genetic aspects of chemical pollution, Sutton (University of Texas, Austin) noted that environmentally induced mutations in somatic cells may threaten the survival of the individual, whereas mutations in germ cells may threaten the survival of a population. Mass screening for human mutagenesis will not be feasible until technology is further developed. It is theoretically possible, Sutton said, to examine 100 million somatic cells to detect very low mutation rates—on the order of 1×10^{-7}. This is an enormous advantage over the currently employed approaches to the study of germinal mutations.

The discussion made clear the fact that the Environmental Protection Agency is responsible for regulatory actions pertaining to chemical pollutants for the population in general, but no federal health organization is responsible for research concerning the special susceptibility of the fetus and child. The participants concluded that there is an urgent need for a national agency to assume responsibility for research in this area.

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Forthcoming Events

June

3–4. **Intestinal Microecology**, 3rd intern. symp., Columbia, Mo. (Conference Section, Continuing Medical Education, M-175 Medical Center, Columbia 65201)

3–6. **Tissue Culture** Assoc., 25th annual, Miami, Fla. (M. Siegel, Univ. of Miami, P.O. Box 520875, Biscayne Annex, Miami 33152)