Frumkin, 2e
Part 4: Environmental Health on a Local Scale

Chapter 25: Children

Children and the Environment

- It is now understood that the environment, on both the micro (chemical) and the macro (structural) level, has a profound ability to affect children's growth and development, exerting positive as well as negative influences.

Patterns of Disease among Children

- The major diseases confronting children in developed nations today are chronic illnesses, such as asthma, congenital malformations, deformations, and chromosomal abnormalities, developmental disorders, such as attention deficit / hyperactivity disorder, and childhood cancer.
  - *Collectively, these diseases are termed the* ***new pediatric morbidity.***
- Evidence is increasing that toxic chemicals in the environment are important causes of disease in children.

Economic Burden of Pediatric Environmental Disease

- The contribution of environmental pollutants to the incidence, prevalence, mortality, and costs of disease in U.S. children is substantial.
- The economic burden of four categories of illness—lead poisoning, asthma, cancer, and neurobehavioral disorders is estimated at $54.9 billion annually in the U.S.

Children's Sensitivity to Environmental Exposures

- **Environmental pediatrics** originated in early studies of major outbreaks of acute disease of toxic origin in children. Outbreaks included lead poisoning in the early 1900s, leukemia in the 40s and 50s, and Minamata disease in Japan in the 60s.
- In the late 1960s, the **American Academy of Pediatrics,** a scholarly body that has been of seminal importance for development of the discipline of environmental pediatrics, was formed.
- There were also four key historical milestones that further advanced the development of environmental pediatrics.

Pesticides in the Diets of Infants and Children, 1993

- The Report on Pesticides in the Diets of Infants and Children found that children have higher levels of exposure to toxicants, that children are less able to deal with exposure than adults, and that children are uniquely vulnerable to effects of toxic exposure because of their lack of development.
- As a result, the report suggested stricter regulations to help protect children against possible exposures and further studies to understand the unique effects of exposure experienced by children.

Food Quality Protection Act, 1996

- **The Food Quality Protection Act** requires that pesticide standards be based primarily on health considerations and that standards be set at levels that protect the health of infants and children.
- It requires that an extra margin of safety be incorporated into pesticide risk assessment when data show that a particular pesticide is especially toxic to infants and children or when data on the toxicity to infants and children are lacking.
- It requires that interactive effects among pesticides be considered. Finally, the FQPA requires that pesticides be assessed systematically for possible endocrine-disrupting effects.

Executive Order on

Children's Health and the Environment, 1997

- **The Executive Order on Children's Health and the Environment** established a cabinet- level oversight committee on children's environmental health, which was given broad responsibility to review the programs of all cabinet agencies to ensure that they were protective of children's health.

The Consumer Product Safety Improvement Act of 2008

- **The Consumer Product Safety and Improvement Act** requires mandatory third-party safety testing and certification of all toys and products marketed to children twelve years of age and younger. It also bans all but trace amounts of lead and the plasticizers called **phthalates** in children's toys and products.

Exposure Through Inhalation: Air Pollutants

- In a New York inner-city neighborhood, various organizations came together to oppose the reopening of a depot for diesel-powered buses near a public elementary school because diesel is recognized as a serious health hazard.
- It contains oxides of nitrogen and particulate matter to which children are particularly sensitive.
- This is because children breathe more rapidly than adults, spend more time playing outside than adults, and can develop chronic diseases later in life as a result of exposure.

Exposure through Ingestion: Pesticides in Food and Water

- Ingestion of contaminated food products is the predominant source of exposure to pesticides for the general population.
- Depending on the pesticide of concern, a variety of health effects have been detected.
- Multiple organ systems may be affected, including the lungs, kidneys, digestive tract, immune system, and central nervous system.
- To reduce pesticide consumption, people are advised to wash or peel their food, eat a variety of types of fruits and vegetables, and to consume organic foods if possible.

Exposure through Skin: DEET

- DEET is a widely bug repellant: in concentrations of less than 30%, it is approved for children. However, higher doses given to children can result in health defects, rarely including Acute DEET toxicity.

Exposure in Utero: Polychlorinated Biphenyls

- Polychlorinated biphenyls (**PCBs**) are a family of synthetic chlorinated hydrocarbon compounds that were used widely from the 1930s until the 1970s as coolants, lubricants, and insulators.
- An outbreak of **Yusho disease** occurred in Japan when PCBs leaked into supplies of Rice Oil, which was consumed by Japanese mothers.
  - *Infants born to the PCB–poisoned mothers had a constellation of symptoms, including mental retardation, developmental delays, eye and skin defects, darkening of the skin, and liver disease.*
- Lower-dose exposure to PCBs in the prenatal period has also been shown to have adverse effects on central nervous function, including decreased intelligence, memory, and attention span.
- There is no known treatment to reduce the levels of PCBs in the body.

Home Exposure: Lead

- Low levels of lead exposure can lead to poor appetite, nausea, vomiting, abdominal pain, and constipation, as well as problems with learning, hyperactivity, and behavior.
- Severe **lead poisoning,** may be associated with neurological symptoms such as changes in mental status, difficulty walking, seizures, and comas.
- Lead can be found in the home in paint, toys, water, and food.
- **X-ray flourescence** can be used to detect lead in patients.

Day-Care Exposure: Solvents

- Steel companies used various hazardous materials, including tetrachloroethylene (PERC), trichloroethylene, and trichloroethane.
- These chemicals can and have gotten into the water and ground around day-care centers.
- High concentrations of tetrachloroethylene can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. Skin irritation may result from repeated or extended skin contact.

School Exposure: Mold

- Schools that experience water damage or pockets of excessive moisture can often have large mold growths.
- Health effects from mold range from irritant effects such as eye, ear, nose, and throat irritations to allergy or asthma symptoms such as sneezing, coughing, and wheezing.
- Determining the source of the moisture is of utmost importance in preventing any further mold growth. Ideally, humidity in schools should be kept between 30 and 50 percent, adequate ventilation with indoor-outdoor air exchange should be ensured, and any water leaks should be addressed immediately.

Play Area Exposure: Arsenic

- Arsenic-treated wood has been used commonly since the 1930s in decks, in playground equipment, and for other outdoor uses.
- A child's hand-to-mouth behavior is the major source of exposure to arsenic from chromated-copper-arsenic-treated wood in play sets.
- Concerns have been raised about arsenic due to its association with an increased risk of developing lung or bladder cancer over a child's lifetime.
- Upkeep of playground equipment is essential to reducing exposure.

Exposure Through Neighborhood Design: Childhood Obesity

- The adverse health effects of the urban environment are apparent in low-income, predominantly minority communities where crowded streets, lack of outdoor playspaces, limited access to fresh and healthy food, and substandard housing all contribute to substantial and well-documented health detriments.
  - As a result of sprawl, people rely much more on cars for transportation, reducing the occasion of walking or biking exercise.
  - The inexpense and high availability of low quality food contributes to unhealthy eating habits.
  - Lack of recreational facilities also decreases outdoor play and involvement in sports, good sources of exercise.

Risk Assessment and Communication

- Traditional **risk assessment** has generally failed to consider the special exposures and the unique susceptibilities of infants and children.
- Child-centered risk assessment that involves exploration of unique pathways of exposure for children, creation of tests of the effects of exposure on development, identification of pediatric diseases due to exposure, and elucidation of pathogenic mechanisms of pediatric disease needs be created.
  - *Improved **exposure assessment,** enhanced **toxicity testing,** new toxicodynamic and toxicokinetic models, a mechanistic approach to hazard assessment, application of **uncertainty factors** and safety factors that specifically consider children's risks, and application of the **precautionary principle** can all aid in protecting children from the harmful effects hazardous exposures.*

Improved Exposure Assessment

- Additional data are needed on children's patterns and levels of exposures to chemicals in the environment.
- Accurate and frequently updated information is needed on children's diets at different ages and on the concentrations of **xenobiotics** (chemicals foreign to the human body) in those diets.
- Exposure estimates for acute effects and exposure estimates for chronic effects need to be constructed differently.

Enhanced Toxicity Testing

- New, more sensitive approaches to chemical toxicity testing are needed that can reliably detect the unanticipated developmental consequences of exposures during critical windows of prenatal and postnatal vulnerability.
- To improve current toxicity testing for certain classes of chemicals, investigators may need to undertake studies in which chemicals are administered to experimental animals either *in utero* or shortly after birth and the subjects then followed over their entire natural life spans.
- Moreover, enhanced functional tests of neurobehavioral, immune, endocrine, and reproductive toxicity are of great importance.

New Toxicodynamic and Toxicokinetic Models

- The physiological and biochemical characteristics of children that influence the metabolism and disposition of chemicals at different stages of development need to be considered in risk assessment.

A Mechanistic Approach to Hazard Assessment

- The pathogenic mechanisms of environmentally induced disease in children need to be elucidated at functional, organ, cellular, and molecular levels.

Application of Uncertainty and Safety Factors Specific to Children's Risks

- In the absence of data to the contrary, children must be presumed to be more vulnerable than adults to environmental toxic agents.

Application of the Precautionary Principle

- When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.

Risk Communication

- Clear **risk communication** on the part of health care providers and collaborative partnerships with agencies and academic centers can do much to provide parents with useful information and to help them respond appropriately to environmental exposures.

The Future of Children's Environmental Health

- In December 2000, the U.S. Congress appropriated funds to plan the **National Children's Study,** a national, longitudinal cohort study of children's health.
- An important goal of this study is to examine systematically the impact on children's health and development of early exposure to environmental toxins. In addition, the study will examine interactions among environmental toxins, socioeconomic factors, behavioral factors, and genetic inheritance and their effects on the health of children.