

Children's Environmental Health: A Brief History



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ABSTRACT

BACKGROUND: Children's environmental health (CEH), the branch of pediatrics that studies the influence of the environment on children's health, has grown substantially in the past 3 decades and become an increasingly visible and important component of pediatric medicine.

GOALS: To trace the historical origins of CEH; to identify factors responsible for its recent growth.

FINDINGS: CEH has historical roots in toxicology, epidemiology, and occupational medicine. It arose in the second half of the 20th century through a melding of insights from pediatric toxicology, nutritional epidemiology, and social science research. Convergent research in these 3 fields has documented children's unique sensitivities to chemical, nutritional, and psychosocial hazards during windows of vulnerability in early development and has shown that early-life exposures can produce disease and disability in childhood and across the life span. Key events in the development of CEH were: 1) formation by the American Academy of Pediatrics in 1957 of a committee on environmental health that has nurtured the growth of the field for 5 decades and evolved into the Council on Environmental Health; 2) observations made in the 1980s that nutritional deficiency in utero increased risk for adult-onset obesity, diabetes,

and cardiovascular disease—work that led to the hypothesis of the developmental origins of health and disease; 3) social science research showing that early exposure to psychosocial stress and trauma increases risk for chronic illness; and 4) publication in 1993 by the National Academy of Sciences of a report, *Pesticides in the Diets of Infants and Children*, which elevated awareness among national policy makers of children's vulnerability to toxic hazards, moved US environmental policy toward protection of children's health, and catalyzed research investment in CEH in the United States and globally.

CONCLUSIONS: CEH has made substantial progress but faces emerging challenges, including new chemicals and pesticides; increasing movement of polluting industries to poor countries where environmental and public health protections are few; and global climate change. In the future, CEH will require continued investment in research and education and will need to adopt an increasingly global perspective.

KEYWORDS: children's environmental health; developmental origins of adult disease; environmental pediatrics; National Children's Study; pediatric environmental health specialty unit

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CHILDREN'S ENVIRONMENTAL HEALTH (CEH), known also as environmental pediatrics, is the branch of pediatric medicine that studies the influence of the environment on children's health, development, and risk of disease.¹ CEH is based on the understanding that children have patterns of exposure and susceptibilities to environmental hazards that are quite different from those of adults. The focus of research and practice in CEH is on the discovery, diagnosis, treatment, and prevention of diseases in children that are associated with harmful exposures in early-life environments.

CEH is highly interdisciplinary. It is concerned with chemical exposure,² the nutritional environment,³ the built environment,⁴ and the psychosocial environment,^{5,6} as well as with interactions among those environments. It is concerned with environmental exposures during pregnancy and before conception as well as with exposures in infancy, childhood, and adolescence. It traces the long-term consequences across the life span of

environmental exposures in early life.³ Further, CEH is inherently translational. It is tightly linked to evidence-based advocacy for child health.

Interest in CEH has grown rapidly in the past 3 decades. This growth has been catalyzed by rising rates of chronic disease in children—asthma, cancer, autism, attention-deficit/hyperactivity disorder, birth defects, cancer, obesity, and diabetes—and by a growing recognition that environmental exposures in early life are powerful determinants of health and disease.¹

Here we trace the historical origins of CEH, review the recent growth of the field, and suggest possible directions for the future.

HISTORICAL ORIGINS OF CEH

The discipline of CEH arose in the second half of the 20th century through a convergence of scientific insights

from 3 fields: pediatric toxicology, nutritional epidemiology, and social science research. This historical paradigm was first elaborated by Fiona Stanley (School of Paediatrics and Child Health, University of Western Australia).

PEDIATRIC TOXICOLOGY

Pediatric toxicology, the study of the effects of toxic chemicals on children's health and development, is the oldest of these 3 disciplines. Many of the methodologies of pediatric toxicology trace back to 2 still older branches of medicine: toxicology and occupational medicine.

CONTRIBUTION OF TOXICOLOGY TO CEH

Toxicology, the study of poisons, studies the adverse effects of chemicals on living organisms and the environment and elucidates the biologic, chemical, and genetic mechanisms underlying those effects.

Toxicology is generally considered to have been founded by Paracelsus (aka Auralius Philippus Theophrastus Paracelsus Bombast von Hohenheim), a Swiss physician of the early 1500s (1493–1541). Paracelsus recognized that toxic chemicals can cause disease and death. He is credited with having coined the aphorism, "Poison is in everything, and no thing is without poison. The dose makes it either a poison or a remedy," a phrase more commonly translated as, "The dose makes the poison."⁷ This was the first recognition of the concept of the dose–response relationship.

CONTRIBUTION OF OCCUPATIONAL MEDICINE TO CEH

Occupational medicine, the study of diseases of workers, has played a pivotal role in the history of CEH because for many centuries toxic exposures and the diseases that they caused were largely confined to the workplace. Methodologies for studying diseases of toxic origin, strategies for assessing environmental exposures, and criteria for judging causality all had their origins in occupational medicine.

Early students of occupational medicine such as the Greek physician-poet Nikander (second century BC), who described lead poisoning in miners and smelter workers,⁸ and the German physician Agricola (1494–1555), who described silicosis in underground hard-rock miners,⁹ provided vivid depictions of diseases of toxic occupational origin. Typically these early studies examined high-dose exposures that produced clinically obvious outcomes. They established that that toxic environmental exposure can cause disease and reaffirmed the validity of the precept that the dose makes the poison.

Bernardino Ramazzini (1633–1714), professor of medicine at the universities of Modena and Padua in northern Italy, is considered to be the father of occupational medicine. In 1700 Ramazzini published his landmark work, *De Morbis Artificum Diatriba* (A discourse on the diseases of workers), the first systematic text in occupational

medicine.¹⁰ Ramazzini provided detailed descriptions of more than 50 diseases of occupational origin. He also presented information on hazardous environmental exposures that was based on direct observation of workers in many trades, including miners, potters, masons, wrestlers, farmers, nurses, priests, nuns, scholars, and soldiers. Ramazzini is the first physician known to have recorded such firsthand assessments of environmental hazards.

Sir Percival Pott (1717–1778), a British surgeon, was another major figure in occupational medicine whose work presages the origins of CEH. Pott's seminal contribution was his observation that young boys (8–15 years of age) who were employed in London as chimney sweeps were at high risk of developing squamous cell cancer of the skin of the scrotum, a disease which in that era was often fatal.¹¹ Pott's description of scrotal cancer in working children was the first published observation of an occupationally induced cancer. The cause was found to be soot containing polycyclic aromatic hydrocarbons that lodged in the folds of the scrotum when these lads were lowered naked into chimneys on a rope. The disease was subsequently prevented by regulations requiring the "climbing boys" to wear coveralls and to bathe at least once a week.

Two major figures in occupational medicine in the United States were Alice Hamilton (1896–1970) and Irving Selikoff (1915–1992). Hamilton, the first woman to be appointed a professor at Harvard Medical School, is renowned for her studies of lead poisoning.¹² Selikoff, who practiced for over 50 years at Mount Sinai Hospital in New York City, is best remembered for his studies documenting increased risk of lung cancer and mesothelioma among workers exposed to asbestos.¹³ Both were powerful advocates for the environment. Selikoff built a program in environmental and occupational medicine at Mount Sinai that has grown into a major center for research and practice in CEH.

In summary, occupational medicine has made important contributions to CEH for the following reasons:

- Working populations are often well defined (through payroll and personnel records), thus facilitating epidemiologic studies and long-term follow-up.
- Workplace exposures are often high-dose exposures and thus lead to relatively rapid appearance of severe, clinically evident disease, including cancers and neurotoxic illnesses.
- Exposures to workers typically precede exposures to children and the general public, sometimes by decades.
- Occupational medicine began in the 1700s and had become a mature medical specialty by the first 2 decades of the 20th century, thus providing intellectual leadership into the field.

MOVEMENT OF TOXIC CHEMICALS FROM THE WORKPLACE TO THE ENVIRONMENT

Beginning early in the 20th century, toxic chemicals began for the first time to move in substantial quantities beyond the workplace and into the general environment. This was a direct consequence of the global rise of the

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