

Manufactured Environmental Toxins and Children's Health: An Evidence-Based Review and Anticipatory Guidance

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ABSTRACT

Manufactured environmental toxins (METs) are a global problem, causing or contributing to health maladies across socioeconomic classes. This article is intended to educate pediatric nurse practitioners (PNPs) about select METs and their effects on the health of children. Infants and children are especially vulnerable to the effects of METs because of their physiological and developmental characteristics. Moreover, PNPs are obligated to be informed about METs and share their knowledge with families via anticipatory guidance so that caregivers can make informed decisions. PNPs should advocate for proper regulation of METs and prevention of their harmful effects. *J Pediatr Health Care.* (2013) 27, 13-22.

KEY WORDS

Environmental health, pediatric, toxin, toxicant

Manufactured environmental toxin (METs), or industrial environmental toxicants, are human-made chemicals that have proven toxic to a component of an

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ecosystem, including animals or humans. In contrast, the term toxin generally refers to a harmful substance produced by natural means. In the past 200 years, the industrial revolution resulted in major changes in agriculture, manufacturing, transport, and technology, during which time more than 83,000 chemicals were created (Environmental Protection Agency [EPA], 2011b). In fact, many chemicals children are currently exposed to were created in the past 50 years (EPA, 2011b). The impact of the industrial revolution on contemporary human life is profound—affecting, and arguably improving, every aspect of daily life. For example, the dominant food system in the United States thrives because of pesticides; without them, lengthy transportation and storage of food would be problematic. The fields of nursing and medicine also have been revolutionized with the advent of industrial products and systems such as plastics, which are now ubiquitous in hospital and surgical settings.

In addition to increasing industrialization, other factors affect MET exposure. Explosive urban population growth, lack of pollution control, global climate change, ozone depletion, electromagnetic radiation, unabated waste dumping, non-sustainable consumption of natural resources, physical inactivity, poor nutrition, and common use of dangerous substances all contribute to environmental issues (World Health Organization [WHO], 2011a).

This article reviews the current regulation of chemicals, the evidence surrounding exposure to various chemicals and METs, and the evidence-based effects of selected METs. Limitations on study of this topic are closely examined. The unique vulnerabilities of the pediatric population also will be explored. Finally,

suggestions for anticipatory guidance and further professional resources are reviewed.

REGULATION

With so many chemicals being utilized in the United States, it is important to ensure proper regulation. In 1976, President Gerald Ford signed into law the Toxic Substances Control Act (TSCA). This legislation has provided the EPA with the “authority to require reporting, record-keeping and testing requirements and restrictions relating to chemical substances and mixtures” (EPA, 2011a). Recently this legislation has come under great scrutiny. Critics believe this legislation needs to be modernized so it provides a higher degree of protection of the American public. Specific critiques of the TSCA include the following:

- “Grandfathering” of 62,000 chemicals that existed at the time the legislation was signed, for which inadequate proof of safety were required
- Exclusion of chemicals used in food, medications, cosmetics, and pesticides
- Lack of transparency within the EPA (some information is not made public, with the reasons cited being “trade secrets” or “confidential business information”)
- A majority of the regulatory document is focused on only three environmental toxins: asbestos, radon and lead (EPA, 2011a; Environmental Working Group [EWG], 2009)

In 2010, new legislation was proposed. Senator Frank Lautenberg (Democrat, New Jersey), chairman of the Senate Subcommittee on Environmental Health, introduced the Safe Chemicals Act of 2010 in an effort to reform chemical regulation. This legislation addresses the aforementioned weaknesses of the TSCA and strengthens the oversight powers of the EPA. For instance, this proposed legislation would require the EPA to categorize chemicals based on risk, ensure that a safety threshold is met for all chemicals on the market, take fast action to address the chemicals that pose the highest risks, and promote innovation and the development of “green” (environmentally safe) chemistry (Safe Chemicals Act of 2010, S. 3209, 2010). Representatives Henry Waxman (Democrat, California), chairman of the House Energy and Commerce Committee, and Bobby Rush (Democrat, Illinois), chairman of the Trade and Consumer Protection Subcommittee, introduced a draft of a similar measure, entitled the Toxic Chemicals Safety Act. This legislation would include funding for a children’s environmental research program (Toxic Chemicals Safety Act, H.R. 5820, 2010). Neither of these bills made it to a vote in the 111th Congress and will require reintroduction in the 112th Congress to be considered further.

VULNERABILITY

Certain populations are at higher risk of toxic effects from chemicals. Children are more vulnerable to METs than adults for the following reasons:

- Infant and child development is dynamic and physiologically complex, requiring vast growth in a predetermined time frame and sequence. The timing of an exposure to a chemical within the course of development will determine its effect. Many well-known examples of this phenomenon exist (e.g., thalidomide and lead)
- Children are closer to the floor, where dust, dirt, residues, and some chemicals are concentrated
- Children have higher metabolic rates than do adults
- Children have higher minute ventilation than do adults
- Children consume more food and liquid than do adults per pound of body weight
- Often the diversity of food consumed by young children is limited compared with that consumed by older children and adults
- Normal developmental exploration by young children (e.g., putting objects into their mouths) may lead to more exposure to chemicals
- Some toxins, such as carbon monoxide, have an affinity for fetal hemoglobin
- Many METs easily pass through the placental barrier, and some METs (such as methyl mercury) have been found to increase in concentration in umbilical cord blood compared with maternal blood
- Lipophilic METs pass easily into breastmilk. Certain pesticides and polychlorinated biphenyls may even concentrate more in breastmilk than they do the maternal blood
- Newborn skin is especially absorptive
- Children have higher gastrointestinal rates of absorption compared with adults
- Because children have more years to live, they have a longer time to develop complications of MET-related injury (American Academy of Pediatrics Committee on Environmental Health, 2003; Grandjean & Landigran, 2006)

LIMITATIONS ON STUDY

Chemicals and environmental health are difficult to study for many reasons, including the following:

- An assay must have been developed to test for the chemical or the chemical metabolite in humans in order to quantify a result
- Not all laboratories are equipped to run specialized chemical testing
- Performing these uncommon tests is expensive
- Different effects occur at different doses

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