



The Growing Pediatric Health Gap: Environmental Injustice Threatens Our Future

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INTRODUCTION

There can be no keener revelation of a society's soul than the way in which it treats its children.
—Nelson Mandela

Nearly a decade ago, we published a paper on the staggering, disproportionate impact of the environmental threats on children's health and the dire need for change through expanding awareness, research, and legislation.¹ We wrote passionately about the myriad health problems—cancer, asthma, autism, obesity—affecting all children, but disproportionately those living in poverty. We explored why children are specifically vulnerable and voiceless as victims of environmental injustice, and we outlined the disastrous consequences of not prioritizing children's health. Yet most current measures of childhood health tell a distressing tale: we are witnessing an ever-growing gap between the current state of children's health and where we ought to be, a rift most egregiously impacting minorities living in poverty.

- *Cancer* remains the leading cause of death by disease in children past infancy in the United States. In 2009, the age-adjusted incidence rate of cancer in children was 171 cases per million, up from 166 cases per million in 2002. On average, pediatric hospitalizations principally for cancer cost almost five times as much as hospitalizations for other pediatric conditions.^{2,3}
- *Asthma* afflicts 9.5% of children in the United States, up from 8.5% in 2004, at an estimated cost of \$27B per year. It is

the leading chronic disease among children and in 2013, asthma accounted for an annual loss of 13.8 million reported missed school days.^{4–6}

- *Food allergies* have emerged in recent years as a major childhood burden: 6% of U.S. children under age 18 suffered from food allergies in 2012, up from approximately 3.9% in 2007, costing the United States about \$25B annually.^{7,8}
- *Childhood obesity* has more than doubled in children and quadrupled in adolescents in the past 30 years. As of 2012, more than one-third of children or adolescents were overweight or obese, and childhood obesity is the number one health concern among parents in the United States. The CDC notes that obesity increases children's risk of developing cardiovascular disease, diabetes, bone and joint problems, and cancer. The direct cost per year attributed to childhood obesity is \$14B; however, lifetime costs are much higher considering that half of obese kids become obese adults, at a cost of nearly \$150B per year.^{9–11}
- Previously considered an adult disease, *metabolic syndrome*, a combination of risk factors that multiply a person's risk for heart disease, diabetes, and stroke, has become a major concern for children. A 2013 study found that 12% of overweight children and 29% of obese children had metabolic syndrome. Its prevalence in childhood and adolescence has increased from approximately 2% in the mid-1990s to a current estimate of 10% in the United States and Western Europe.¹²
- Between 2001 and 2009, the prevalence of type 1 diabetes increased 20% and the rates of type 2 diabetes rose 30%. Type 2 diabetes, once known as

“adult-onset” diabetes, now accounts for up to 50% of new diagnoses, disproportionately affecting minority groups. The annual cost of medical care for children with diabetes is six times higher than medical care for kids without.^{13,14}

- *Developmental disabilities* impact roughly 1 in 6 children aged 3–17 years. About 1 in 68 children have been identified with *autism spectrum disorder* (ASD), which occurs across all racial, ethnic, and socioeconomic groups—an increase of more than 50% since our 2007 paper was published. Alarming, even more recent estimates suggest the actual rate may be 1 in 45. The total costs per year for children with autism are estimated to be between \$11.5 and \$60B.^{15–17}
- As of 2012, 1 in 10 children aged 3–17 years had been diagnosed with *attention-deficit/hyperactivity disorder* (ADHD), up from 1 in 12 children in 2007. Rates of ADHD are higher for boys, and also among children with fair or poor health status. The annual societal “cost of illness” for ADHD is estimated to be between \$36 and \$52B, but that figure is based on a projected 5% prevalence rate. At the current 10% rate, costs may reach in excess of \$100B per year.^{18,19}
- *Mental health disorders* afflict just over 20% of children at some point in their lives. These include mood disorders, anxiety disorders, and eating disorders. *Suicide* was the second leading cause of death among children aged 12–17 years in 2010, up from the third leading cause when we wrote our initial paper. Mental health disorders are among the most costly conditions to treat in children, costing approximately \$250B annually.^{20–22}

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- *Drug prescriptions* for pediatric emotional, behavioral and mental health conditions are up dramatically. In children aged two years and younger, astoundingly, nearly 83,000 prescriptions for the antidepressant fluoxetine were written in 2014, a 23% increase from the year before. In this same age group, almost 20,000 prescriptions for antipsychotic medications were written in 2014, a 50% jump from the prior year. Prescriptions for ADHD also continue to rise, particularly in boys 12–18 years old. In 2012, 9.3% of boys in that age group were prescribed ADHD medications, up from 7.9% in 2008.^{23,24}

EMERGING ISSUES

What these conditions have in common, in addition to a continued increase in incidence and corresponding rising costs to society, are strong evidence-based links to environmental triggers. In our original article, we focused on the synergistic role of adverse environmental exposures and social conditions, such as poverty, that impact children's health on a global scale. During the intervening years, several new environmental threats have emerged as daunting foes in the war on children's health: climate change, toxic stress, and electromagnetic radiation.

Climate Change

Defined by the U.S. Environmental Protection Agency as “any significant change in the measures of climate lasting for an extended period of time,”²⁵ climate change includes major shifts over time in temperature, precipitation, or wind patterns. The current impact of these changes on human health is already astonishing, and future projections are dire—particularly for children. Sheffield and Landrigan, in a review article published in *Environmental Health Perspectives*, blame climate change for more than 150,000 deaths worldwide in the year 2000, noting that 88% of this disease burden fell on children.²⁶ They describe the disproportionate vulnerability of children to climate-related environmental endangerments, citing the magnified additional effects of exposures during gestation, as “prenatal or

childhood exposure to specific toxins, toxicants, infectious agents, or conditions such as undernutrition can produce disease and dysfunction that lasts through childhood and in some cases first manifests only in adulthood.” Children once again are bearing the brunt of the impact, victims of further environmental injustice.

In a 2015 policy statement on Global Climate Change and Children's Health, the American Academy of Pediatrics (AAP) concurred, noting that failure to take prompt, substantive action on climate change is tantamount to an “act of injustice to all children.”²⁷ The effects of climate change on children's health vary based on geographic location and socioeconomic status, and include both direct and indirect threats to physical and emotional well-being. Direct dangers include catastrophic injury and death from natural disasters, rising heat impacts on water and food needs, increased air pollution leading to respiratory and other health adverse impacts, and post-traumatic stress conditions. Indirect menaces include new and rising infectious disease epidemics, worsening poverty, nutritional depletion, increased exposures to toxic chemicals, diminished school attendance and educational challenges, and, finally, increased rates of pregnancy complications.

The AAP report urges timely action, remarking, “Climate change is not about a distant, unforeseeable future. It is about the world in which our children live today and the future in which they will raise their own children.” Reversing climate change is a global challenge, perhaps the greatest of our age. Effective strategies to limit the negative impacts on children's well-being require addressing climate change health hazards as part of an overall integrated world health strategy. We must prioritize research and policy efforts to address climate change-related pediatric environmental health concerns. Envisioning children's health as deeply connected to maternal health and educational concerns directs us to consider a more holistic ecological solution.

Toxic Stress

No child is immune to stress, the body's natural reaction to threatening situations, whether temporary or sustained.

Learning to cope with acute stress is necessary for healthy development. Exposure to malevolent chronic stressors is incredibly harmful—to anyone, but especially to children—and has lifelong physical and psychological consequences.

The Center for the Developing Child at Harvard University highlights three kinds of stress responses typical in children, distinguishing between positive and tolerable responses from what is now known as the toxic stress response, or “the strong, unrelieved activation of the body's stress management system in the absence of protective adult support.”²⁸ This toxic stress response may occur as a reaction to a range of adverse circumstances: physical or emotional abuse; chronic neglect; caregiver substance abuse and mental illness; exposure to violence; and/or the accumulated burdens of family economic hardship. When the body's stress response systems are activated in the prolonged manner that toxic stress requires, health ramifications can be profound. A landmark 2012 AAP report, “The Lifelong Effects of Early Childhood Adversity and Toxic Stress,” details potentially permanent adverse impacts of toxic stress on children's emotional and physical health, including heart disease, depression, and substance abuse.²⁹ There is growing evidence that toxic stress early in life can also lead to persistent socioeconomic inequalities and widening health disparities. The report points out, “The lifelong costs of childhood toxic stress are enormous, as manifested in adverse impacts on learning, behavior, and health, and effective early childhood interventions provide critical opportunities to prevent these undesirable outcomes and generate large economic returns for all of society.” Acknowledging the role of toxic stress in children's health now and into adulthood stands to have enormous benefits.

How should we approach such a complex challenge? It is clear from the surge in pediatric psychopharmacological prescriptions that the conventional answer to date has been to indiscriminately medicate emotional symptoms rather than investigate underlying causes and consider effective community-wide integrative strategies. Promisingly,

a 2012 AAP policy statement³⁰ proposes a novel ecobiodevelopmental (EBD) framework for understanding the promotion of health and prevention of disease across a lifespan. From a toxic stress perspective, this means no longer viewing psychosocial problems as categorically different from the causes and consequences of other biologically based health impairments. We must consider the relative roles a broad array of environmental factors (from social relationships to chemical exposures) play in influencing genetic and epigenetic predispositions. The EBD paradigm is truly integrative and should inform future research, educational, clinical, and policy strategies. Additionally, addressing childhood adversity requires acknowledging not only that toxic stress exists but also that protective relationships with supportive adults may not. As such, medical professionals must work together with families, educators and policy makers to identify children at high risk for toxic stress, locate necessary services, and develop culturally effective preventive strategies and action plans.

Electromagnetic Radiation

The exponential rise of personal technology use, including cellular phones, has led to an unprecedented increase in environmental exposures to electromagnetic radiation (EMR). The World Health Organization (WHO) acknowledges EMR as “one of the most common and fastest growing environmental influences” and that levels will only continue to increase as technology advances.³¹ A 2015 study of an urban, low-income, minority community found that 75% of four-year olds had their own mobile electronic device, and nearly all used mobile devices on a daily basis—most before the age of one.³² Why are we concerned about increased cell phone use and EMR? It is an accepted scientific fact that EMR has an effect on biological tissues.³³ Though this impact is not yet proven to cause disease, EMR can generate heat, subsequently absorbed by tissues in the human body nearest to where the phone is being held—the brain and skull near the ear. Some dose of and length of exposure to EMR, unknown for each child, may ultimately

cause cellular and metabolic imbalances leading to cancer or neurological disruption. As with most environmental threats, children are particularly at risk. A 2014 review of the current literature showed that children face a higher health risk than adults from EMR emitted by wireless devices, as “the rate of absorption is higher in children than adults because their brain tissues are more absorbent, their skulls are thinner, and their relative size is smaller.”³⁴ Fetuses may be particularly vulnerable, as EMR exposure can result in degeneration of the protective myelin sheath that surrounds brain neurons, the cells that transmit nerve signals to and from the brain. This concept highlights the fact that children are doubly exposed to potential environmental stressors like EMR—during pregnancy and after birth.

The National Cancer Institute maintains “to date there is no evidence from studies of cells, animals, or humans that radiofrequency energy can cause cancer,”³⁵ and the Federal Communications Commissions (FCC), which regulates allowable cell phone EMR emissions, finds “no scientific evidence currently establishes a definite link between wireless device use and cancer or other illnesses.”³⁶ Yet there remains much uncertainty—and apprehension—with virtually no published data on the short- and long-term pediatric health effects from EMR exposure. Many environmental researchers and advocates urge caution. A letter released in 2015 by 190 independent scientists from 39 countries (including the United States) called on the WHO, the United Nations, and national governments to develop more protective exposure guidelines on cell phones, wearable devices, and other products that create electromagnetic fields (EMF) “in the face of increasing evidence of risk.”³⁷ Referring to EMF as a form of “environmental pollution,” the letter further notes that the WHO guidelines fail to take into account the concerns of its own International Agency for Research on Cancer (IARC), which previously classified radiofrequency radiation as a Group 2B possible carcinogen. The AAP in 2013 implored the FCC to revamp standards and reassess “current policy to determine if it

is adequately protective of human health,” recognizing the growing use of wireless technology by infants and toddlers.³⁸ Until we can establish safe parameters through ongoing research efforts, we should promote strategies and adopt policies minimizing childhood EMR exposure.

CONCLUSION

When we limit our children's ability to achieve optimal health, we squander the potential of generations to come. In the decade since we wrote our initial call-to-action, historical environmental threats like lead poisoning continue to disproportionately harm poor, urban minority children, while emerging concerns like climate change, toxic stress and electromagnetic radiation add to the burden. It appears that the moral argument to urgently address pediatric environmental health perils has failed thus far to result in any substantive investment in public health measures to reverse the worsening health trends previously cited. While we will continue to strongly advocate that such investments are, simply, the right thing to do, we recognize that in order to create meaningful and sustainable change, we must also make the case that our children's health is directly tied to our economic future.

More than 16 million U.S. children now live in poverty, and the number continues to rise, with nearly half of all children in what is called “the richest country in the world” now living in low-income and poor families.³⁹ It is well established that these children are in worse physical, emotional, and cognitive health than their peers. National surveys consistently indicate that poor children are more likely to experience reduced access to preventive and acute care, resulting in higher rates of hospital admissions, disability days, and death rates.⁴⁰ The American Psychological Association notes that poor children are “at greater risk for several negative outcomes such as poor academic achievement, school dropout, abuse and neglect, behavioral and socioemotional problems, physical health problems, and developmental delays.” Furthermore, “Economists estimate that child poverty costs an estimated \$500 billion a year to

the U.S. economy; reduces productivity and economic output by 1.3% of GDP; raises crime and increases health expenditure.⁴¹ According to the AAP Policy, *Effect of Child and Family Poverty on Child Health in the United States*, "Millions of children who are poor are particularly vulnerable to the effects of poverty because of the environment in which they live."⁴⁰ To what degree do environmental factors contribute to healthcare costs? The most comprehensive assessment to date estimates the direct contribution of environmental health threats to pediatric healthcare costs as approximately \$55 billion, or 2.8% of total U.S. healthcare costs.⁴² It is likely that these figures are gross underestimates of the total costs to society. Poor childhood physical and emotional health, coupled with educational failure, leads to poor adult health and decreased wage-earning potential, a downward spiral toward an ever-widening health—and, ultimately, opportunity—gap.

The WHO Bulletin, *Investing in children's health: what are the economic benefits?* Offers a detailed analysis of the return-on-investment for prioritizing children's health programs, arguing, "The conclusion that can be drawn from the literature studying the relationship between children's health and the economy is that children's health is a potentially valuable economic investment."⁴³ Children, though, appear no longer to be a national priority. Despite representing nearly 25% of the U.S. population, they receive only 13% of dollars allocated to federal programs.⁴⁴ Given the tremendous costs of pediatric health ills, one would expect a significant investment in pediatric research. Sadly, NIH funding for children's health research stands at a flat \$3B, a decreasing percentage of the total NIH budget. What can be done to right our national priorities, reverse these trends, and narrow the pediatric health gap?

Create a True Healthcare System That Prioritizes and Incentivizes Primary Care

Prevention, particularly for environmental health concerns, is far safer, more effective and cost-effective than treatment after diagnosis. We have seen this with lead poisoning efforts, as an

example.⁴⁵ However, current economics favor disease-treatment models, increasing risk and cost while not improving long-term health measures. Increasing access to patient-centered primary care medical homes decreases healthcare costs while improving health outcomes.⁴⁶ In particular, integrative health systems prioritize preventive cost-effective lifestyle approaches, addressing social determinants of health like nutrition, exercise, free play, access to nature, and toxic stress. Funding of promising pilot programs like the integration of health coaches in primary care settings to assist families with nutrition and mental health strategies may be one innovative method to improve health outcomes at reduced cost.⁴⁷

Design and Implement Interprofessional Education Promoting Environmental Health Screening and Prevention Strategies

Pediatricians, nurses, and many other health professionals are on the front lines working with children faced with environmental health hazards. To increase awareness of the value of preventive strategies, we must develop accessible and engaging interprofessional educational programs covering both historical and emerging concerns. As a first step, every professional in contact with children should feel competent in collecting a comprehensive pediatric environmental health history.⁴⁸ In every community, particularly those with historically poor access to primary care, we need to engage and listen to community members to learn what environmental factors most concern them.

Increase Pediatric Environmental Health Research Funding Proportionately With its Economic Impact

In particular, we should fund innovative, integrative strategies that examine complex interactions of biological and social factors impacting children's health. We need to consider novel, translational methods of investigation when faced with thorny new dangers like climate change, toxic stress and EMR exposure. We should more seriously consider the efficacy and cost-effectiveness of preventive strategies,

evaluating partnerships between health and education professionals and institutions. NIH funding for pediatric environmental health research needs to increase, reflecting the great cost to society if we continue to ignore the tremendous scope of the problems we face.

We Must Advocate for Policies That Preemptively Limit Exposure to Potential Toxins Before the Damage is Done

We must heed the lessons learned from the tremendous harm done by tobacco and lead, as prime examples. For too long, industry lobbyists assured us these products were safe despite no proof of such, and ultimately generations of children have paid—and continue to pay—the price.

There are few effective measures in place to protect children (and all of us) from the potentially catastrophic consequences of exposure to chemicals. The Toxic Substances Control Act (TSCA)⁴⁹ was signed into law 40 years ago, but it has never actually succeeded at controlling toxic substances, thwarted and diluted by chemical industry lobbyists and the politicians they have influenced. Only a tiny number of the tens of thousands of chemicals that have entered the marketplace since TSCA was passed have been tested for safety. Attempts to reform TSCA have been disappointing, and new legislation must contain stronger, more proactive measures to safeguard human health—not the chemical industry. We continue to advocate for greener chemical alternatives, requiring proof of human safety—specifically for children—before approval. We also push for full labeling transparency, no different than requiring food producers to list all ingredients (including labeling GMOs). Manufacturers must do the same for personal care products, cleaning products, plastic items, and all other items families use and consume on a daily basis.

Above All, We Must Stand Up and Act for Our Children, The Ones Most Harmed and the Ones With No Voice

Speaking for them is not enough. Politicians and public leaders have too long given lip service to supporting children's health needs while we continue to

witness the slow and steady destruction of a generation. Old and new environmental health threats significantly contribute to still-rising rates of chronic physical, emotional, and neurodevelopmental disorders, robbing countless children—and our country—of a brighter future. We are only as strong as our dedication to ensuring an equal opportunity for all, regardless of race, color, national origin, income, and age. Abolishing environmental injustice can serve as the linchpin to narrowing the pediatric health gap, once and for all.

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