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CHILDREN'S HEALTH COLLECTION 2010

October 2009–September 2010

www.ehponline.org

NIH PUBLICATION 2010-218
ISSN 0091-6765

Disease Outcomes

- Asthma/Respiratory Disease and Lung Development
- Neurodevelopmental and Neurobehavioral Disorders
- Childhood Leukemia
- Cancer
- Birth Defects
- Pregnancy Outcomes: Preterm Birth, Small for Gestational Age, and Fetal Development
- Immune-based Disease
- Autism
- Fetal or Early-life Exposures Contributing to Adult Disease
- Hormonal Development

Exposures

- Heavy Metals
- Pesticides
- Other Chemicals (BPA, PCBs, PBDEs, PFCs, Phthalates)
- Built Environment
- Climate Change
- Food Safety and Nutrition
- Methodologies

PREFACE

Children are not “little adults.” Proportionate to body size, children breathe more air, ingest more food and water, have higher metabolic rates, and thus absorb more toxicants than adults do. Because their nervous, respiratory, and immune systems are not fully developed, children are less able than adults to process and eliminate toxicants from their bodies. During various stages of development, windows of exposure occur during which the fetus or child is unusually vulnerable to environmental hazards. And close proximity to the floor and ground as well as hand-to-mouth behaviors make children extremely susceptible to toxicants found in floor, dirt, and heavy air. A child’s nurturing environments—the womb, home, child care settings, school, and community—can contain lead and other metals, endocrine disruptors, in-home and agricultural pesticides, allergens, solvents, neurotoxicants, and indoor and outdoor air pollutants. Moreover, environmental hazards can disproportionately affect children of lower-income and minority communities through closer proximity to busy roads, industrial facilities, and hazardous waste sites; contaminated soil; and factors associated with dilapidated housing such as lead-based paint, dust mites, molds, vermin, and higher pesticide use.

Because children are uniquely sensitive to their environments, *EHP* devotes a research section each month specifically to issues surrounding children’s environmental health, and each year the October issue is largely devoted to these topics. *EHP*’s research and news sections provide information on environmental hazards and medical outcomes in children—from conception to late adolescence—to scientists, physicians and other health professionals, policy makers, advocates, and communities around the world.

Children’s Health Collection 2010 comprises peer-reviewed research articles (including reviews and commentaries), news articles, editorials, and podcasts published in the past year. These are divided into two main sections—Disease Outcomes and Exposures—with more specific topics within each. With each research article is a brief summary of the objective and results. Each title is hyperlinked to take readers directly to the full article on our website (<http://www.ehponline.org>). Once you’re on our site, we invite you to keep browsing. All *EHP* articles can be searched by author, key word, or phrase, and although this year we may have published only one or two articles on a particular topic, a click and a search will provide additional research published previously.

EHP is committed to making information about environmental risks to children easily accessible to a variety of readers. Together, we can work to reduce or prevent environmental hazards and improve the health of all children—and the adults they will someday be.



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TABLE OF CONTENTS



CHILDREN'S
HEALTH
COLLECTION 2010

OCTOBER 2009–SEPTEMBER 2010
www.ehponline.org

Disease Outcomes

Asthma/Respiratory Disease
and Lung Development

Neurodevelopmental and
Neurobehavioral Disorders

Childhood Leukemia

Cancer

Birth Defects

Pregnancy Outcomes: Preterm Birth, Small for
Gestational Age, and Fetal Development

Immune-based Disease

Autism

Fetal or Early-life Exposures Contributing
to Adult Disease

Hormonal Development

Exposures

Heavy Metals

Pesticides

Other Chemicals
(BPA, PCBs, PBDEs, PFCs, Phthalates)

Built Environment

Climate Change

Food Safety and Nutrition

Methodologies

Disease Outcomes

ASTHMA/RESPIRATORY DISEASE AND LUNG DEVELOPMENT

Formaldehyde Exposure and Asthma in Children: A Systematic Review

Gerald McGwin Jr., Jeffrey Lienert, John I. Kennedy Jr. (March) 118:313–317.

It has been proposed that formaldehyde may influence the risk or severity of asthma through irritant effects by stimulating allergic responses (when linked with endogenous proteins) or by inhibiting bronchodilation, but findings of observational studies of childhood asthma and formaldehyde have been inconsistent. McGwin et al. conducted a systematic review and quantitative meta-analysis of seven peer-reviewed studies that included children with and without asthma and reported formaldehyde exposure levels and estimates of association. Pooled odds ratios (ORs) from both fixed-effects and random-effects models (that account for heterogeneity among studies) indicated positive associations for all studies combined [for a 10- $\mu\text{g}/\text{m}^3$ increase in formaldehyde, fixed-effects OR = 1.03; 95% confidence interval (CI), 1.02–1.04; random-effects OR = 1.17; 95% CI, 1.01–1.36] and for study subgroups classified according to a variety of characteristics. Results support an association between formaldehyde and childhood asthma, but the authors note that estimates are based primarily on cross-sectional studies without comprehensive individual exposure measurements, information on potential confounders, or diagnostic confirmation, and they conclude that well-designed prospective studies are needed to confirm these findings.

NEWS | SCIENCE SELECTION

Formaldehyde Exposure among Children: A Potential Building Block of Asthma

ASTHMA/RESPIRATORY DISEASE AND LUNG DEVELOPMENT

Impact of Environmental Chemicals on Lung Development

Mark D. Miller, Melanie A. Marty (August) 118:1155–1164.

Disruption of fundamental biological processes and associated signaling events may result in clinically significant alterations in lung development. Miller and Marty reviewed literature concerning the impact of environmental chemicals on lung development, key signaling events in lung morphogenesis, and the relevance of potential outcomes to public health and regulatory science. *In utero* and early postnatal exposure to environmental agents can influence childhood lung structure and function and may predispose individuals to chronic obstructive lung disease and other disorders later in life; the nutritional and endogenous chemical environment can also affect development of the lung and result in altered function in the adult. Studies now suggest that adverse impacts on the lung may occur after exposure to environmental agents during critical windows of pulmonary development. Potential mechanisms of delayed effects include interference with highly conserved factors in developmental processes such as gene regulation, molecular signaling, and growth factors involved in branching morphogenesis and alveolarization. The authors stress that assessing effects of environmental chemicals on lung development requires end points not regularly included in standard toxicity tests. Research to identify effects of environmental agents on critical signaling events may eventually lead to more comprehensive testing protocols for risk assessment.

ASTHMA/RESPIRATORY DISEASE AND LUNG DEVELOPMENT

Short-Term Effects of PM₁₀ and NO₂ on Respiratory Health among Children with Asthma or Asthma-like Symptoms: A Systematic Review and Meta-Analysis

Gudrun Weinmayr, Elisa Romeo, Manuela De Sario, Stephan K. Weiland, Francesco Forastiere (April) 118:449–457.

Both PM₁₀ (particulate matter < 10 μm in aerodynamic diameter) and NO₂ (nitrogen dioxide) have been shown to be associated with increased frequency of asthma symptoms with lung function decrements in children. Although meta-analyses on the short-term effect of PM₁₀ have been performed, quantitative meta-analyses on the effect of NO₂ have not been. Weinmayr et al. estimated the acute effects of short-term exposure to PM₁₀ and NO₂ on respiratory symptoms and lung function in asthmatic children based on a meta-analysis of currently published panel studies. After a systematic literature review, the authors derived quantitative estimates of the association of PM₁₀ and/or NO₂ with respiratory symptoms and peak expiratory flow (PEF). Based on 36 studies, 14 of which were part of the European Pollution Effects on Asthmatic Children in Europe (PEACE) Study, associations of PM₁₀ with asthma symptoms were statistically significant. NO₂ had statistically significant associations with asthma symptoms in the overall analysis considering all possible lags, but not when only a 0–1 lag was evaluated. Publication bias was not evident, except when the PEACE studies were excluded. There was an indication for stronger PM₁₀ effects for studies conducted in summer, outside of Europe, with longer lags, and in locations with higher NO₂ concentrations. The authors conclude that although there were clear associations of PM₁₀ with asthma episodes, the results for NO₂ were less consistent.

ASTHMA/RESPIRATORY DISEASE AND LUNG DEVELOPMENT

Air Pollution, Aeroallergens, and Emergency Room Visits for Acute Respiratory Diseases and Gastroenteric Disorders among Young Children in Six Italian Cities

Flavia Orazio, Luigi Nespoli, Kazuhiko Ito, Davide Tassinari, Daniela Giardina, Maurizio Funis, Alessandra Cecchi, Chiara Trapani, Gisella Forgeschi, Massimo Vignini, Luana Nosetti, Sabrina Pigna, Antonella Zanobetti (November) 117:1780–1785.

Associations between air pollution and respiratory symptoms and morbidity in children have been reported by multiple studies, but relatively few have examined associations in very young children, and none have examined associations with gastrointestinal illnesses. Orazio et al. conducted a case-crossover study of ambient air pollution [particulate matter (PM), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), ozone, and carbon monoxide (CO)] and emergency room visits for wheezing and gastroenteric illness (acute enteric disease with diarrhea and vomiting) in children 0–2 years of age from six Italian cities. CO and SO₂ were most strongly associated with wheezing, with a 2.7% increase (95% CI, 0.5–4.9) estimated in association with a 1.04- $\mu\text{g}/\text{m}^3$ increase in 7-day average CO and a 3.4% (95% CI, 1.5–5.3) increase with a 8.0- $\mu\text{g}/\text{m}^3$ increase in SO₂. The authors found positive associations with visits for wheezing for PM and NO₂ and a significant association between the 3-day moving average CO level and gastroenteric disorders. Results are consistent with adverse health effects of air pollution in children 0–2 years of age, but the authors conclude that additional research is needed to investigate underlying mechanisms.

ASTHMA/RESPIRATORY DISEASE AND LUNG DEVELOPMENT

Self-Reported Truck Traffic on the Street of Residence and Symptoms of Asthma and Allergic Disease: A Global Relationship in ISAAC Phase 3

Bert Brunekreef, Alistair W. Stewart, H. Ross Anderson, Christopher K.W. Lai, David P. Strachan, Neil Pearce (November) 117:1791–1798.

Multiple studies have reported associations between traffic-related air pollution and allergic outcomes in children, but most have been conducted only among children in developed countries. Brunekreef et al. describe associations between truck traffic on the street of residence and symptoms of asthma, rhinoconjunctivitis, and eczema among 13- to 14-year-old children ($n = 315,572$ from 110 centers in 46 countries) and 6- to 7-year-old children ($n = 197,515$ from 70 centers in 29 countries) in the third phase of the International Study of Asthma and Allergies in Childhood (ISAAC). The frequency of truck traffic was associated with the prevalence of asthma, rhinoconjunctivitis, and eczema symptoms. Adjusted odds ratios (95% CIs) for “current wheeze” and “almost the whole day” versus “never” truck traffic were 1.35 (1.23–1.49) for 13- to 14-year-olds and 1.35 (1.22–1.48) for 6- to 7-year-olds, with remarkably similar associations estimated throughout the world. The authors conclude that findings merit further investigation given increasing exposure of the world’s children to traffic.

ASTHMA/RESPIRATORY DISEASE AND LUNG DEVELOPMENT

Effect of Early Life Exposure to Air Pollution on Development of Childhood Asthma

Nina Annika Clark, Paul A. Demers, Catherine J. Karr, Mieke Koehoorn, Cornel Lencar, Lillian Tamburic, Michael Brauer (February) 118:284–290.

Air pollution has been consistently associated with asthma symptoms, but relatively few studies have evaluated early life exposures and asthma onset. Clark et al. conducted a nested population-based case-control study of childhood asthma diagnosed up to 3–4 years of age among children born in southwestern British Columbia in 1999 and 2000, including 3,482 eligible cases (with a history of hospitalization or at least two asthma diagnoses) and 17,410 age- and sex-matched controls. Administrative and health care data were used to identify eligible children and obtain information on residential histories and potential confounders. Air pollution exposures during pregnancy and the first year of life [specifically, to carbon monoxide, nitric oxide, nitrogen dioxide, particulate matter $\leq 10 \mu\text{m}$ (PM_{10}) and $\leq 2.5 \mu\text{m}$ ($\text{PM}_{2.5}$) in aerodynamic diameter, ozone, sulfur dioxide, black carbon, woodsmoke, and proximity to major roads and industrial point sources] were estimated using regulatory monitoring data and land use regression models adjusted for temporal variation. Early life exposures to CO, NO, NO₂, PM₁₀, SO₂, black carbon, and industrial point sources were positively associated with asthma, with the strongest associations noted for traffic-related pollutants. The authors conclude that results support effects of early exposure to air pollutants on the development of childhood asthma.

NEWS | SCIENCE SELECTION

Traffic Marker? Early Exposure to Air Pollution Associated with Childhood Asthma

RELATED ARTICLES

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Better Burning, Better Breathing: Improving Health with Cleaner Cook Stoves

Tina Adler (March) 118:A125–A129.



NEWS | FORUM

Less Pollution, Less Earache?

Carol Potera (December) 117:A540.

NEWS | FORUM

Secondhand Smoke Exposure May Alter Fetal Blood Pressure Programming

Adrian Burton (April) 118:A158–A159.

ASTHMA/RESPIRATORY DISEASE AND LUNG DEVELOPMENT

Exposures to Particulate Matter and Polycyclic Aromatic Hydrocarbons and Oxidative Stress in Schoolchildren

Sanghyuk Bae, Xiao-Chuan Pan, Su-Young Kim, Kwangsik Park, Yoon-Hee Kim, Ho Kim, Yun-Chul Hong (April) 118:579–583.

Air pollution is known to contribute to respiratory and cardiovascular mortality and morbidity, and oxidative stress has been suggested as one of the main mechanisms for these effects on health. Bae et al. studied the effects of exposure to particulate matter (PM) $\leq 10 \mu\text{m}$ in aerodynamic diameter (PM₁₀), PM $\leq 2.5 \mu\text{m}$ in aerodynamic diameter (PM_{2.5}), and polycyclic aromatic hydrocarbons (PAHs) on urinary malondialdehyde (MDA) levels in schoolchildren. The survey and measurements were conducted in four cities, two in China (Ala Shan and Beijing) and two in Korea (Jeju and Seoul). Daily ambient levels of PM and their metal components and urinary levels of 1-hydroxypyrene (1-OHP) and 2-naphthol (to assess PAH exposure) and MDA (to assess oxidative stress) were measured once a day for 5 consecutive days. A linear mixed model adjusted for individual variables was used to estimate the effects of PM and PAH on oxidative stress. The authors report that urinary MDA levels were associated with ambient PM concentrations and that urinary 1-OHP levels associated with urinary MDA level. Outdoor PM and urinary 1-OHP appeared to have synergistic effects on urinary MDA levels. Some metals bound to PM₁₀ (aluminum, iron, strontium, magnesium, silicon, arsenic, barium, zinc, copper, and cadmium) and PM_{2.5} (magnesium, iron, strontium, arsenic, cadmium, zinc, aluminum, mercury, barium, and copper) were also associated with urinary MDA level. The authors conclude that exposure to PM air pollution and PAHs was associated with oxidative stress in schoolchildren.

ASTHMA/RESPIRATORY DISEASE AND LUNG DEVELOPMENT

¹³⁷Cesium Exposure and Spirometry Measures in Ukrainian Children Affected by the Chernobyl Nuclear Incident

Erik R. Svendsen, Igor E. Kolpakov, Yevgenia I. Stepanova, Vitaliy Y. Vdovenko, Maryna V. Naboka, Timothy A. Mousseau, Lawrence C. Mohr, David G. Hoel, Wilfried J.J. Karmaus (May) 118:720–725.

The short-term effects on the lung and pulmonary system following acute high-dose exposure to radiation are relatively well known. However, there has been comparatively little research on the long-term health effects of radioisotope exposure on the respiratory system. After the Chernobyl accident in 1986, children of the contaminated Narodichesky region of Ukraine were exposed to ¹³⁷cesium (¹³⁷Cs) in contaminated soils, air, and food. Using a longitudinal prospective cohort study design, Svendsen et al. investigated associations between mean baseline soil ¹³⁷Cs levels in each village and spirometry measures based on 1,888 repeated measurements in 415 children from 1993 to 1998. The authors report that chronic exposure to low-dose radioactive contaminants found downwind of the Chernobyl nuclear power plant was associated with airway obstruction and restriction in children living in the Narodichesky region.

ASTHMA/RESPIRATORY DISEASE AND LUNG DEVELOPMENT

Airborne Endotoxin Concentrations in Homes Burning Biomass Fuel

Sean Semple, Delan Devakumar, Duncan G. Fullerton, Peter S. Thorne, Nervana Metwali, Anthony Costello, Stephen B. Gordon, Dharma S. Manandhar, Jon G. Ayres (July) 118:988–991.

About half of the world's population is exposed to smoke from burning biomass fuels at home, and the health burdens of these exposures have been well described. Burning unprocessed biological material such as wood and dried animal dung may also produce high concentrations of endotoxin, but there is limited information on endotoxin levels in these homes. Semple et al. sampled air in homes burning wood or dried animal dung in 31 homes in Nepal, and wood, charcoal, or crop residues in 38 homes in Malawi. Averaged over 24 hr in Malawian homes, median concentrations of total inhalable endotoxin were 24 endotoxin units (EU)/m³ in charcoal-burning homes and 40 EU/m³ in wood-burning homes. Short-cooking-time samples collected in Nepal produced median values of 43 EU/m³ in wood-burning homes and 365 EU/m³ in dung-burning homes. These results suggest increasing endotoxin levels with decreasing energy levels in unprocessed solid fuels. The authors note that airborne endotoxin concentrations in homes burning biomass fuels are orders of magnitude higher than those found in homes in developed countries where endotoxin exposure has been linked to respiratory illness in children. The authors also note the need for health studies to examine the long-term effects of exposure to endotoxin in children.

▼ NEWS | SCIENCE SELECTION

Endotoxin from Biomass Burning: An Underestimated Health Hazard?

ASTHMA/RESPIRATORY DISEASE AND LUNG DEVELOPMENT

Childhood Incident Asthma and Traffic-Related Air Pollution at Home and School

Rob McConnell, Talat Islam, Ketan Shankardass, Michael Jerrett, Fred Lurmann, Frank Gilliland, Jim Gauderman, Ed Avol, Nino Künzli, Ling Yao, John Peters, Kiros Berhane (July) 118:1021–1026.

Traffic-related air pollution has been associated with adverse cardiorespiratory effects, including increased asthma prevalence. McConnell et al. evaluated the relationship of new-onset asthma with traffic-related pollution near homes and schools. Parent-reported physician diagnosis of new-onset asthma was identified during 3 years of follow-up of a cohort of kindergarten and first-grade children who were asthma- and wheezing-free at study entry into the Southern California Children's Health Study. Traffic-related pollution exposure was assessed based on a line source dispersion model of traffic volume, distance from home and school, and local meteorology. Regional ambient ozone, nitrogen dioxide (NO₂), and particulate matter were measured continuously at one central site monitor in each of 13 study communities. The authors report an increase in asthma risk with modeled traffic-related pollution exposure from roadways near homes and schools. Ambient NO₂ was also associated with increased risk. Models that included both NO₂ and modeled traffic exposures suggested independent associations of asthma with traffic-related pollution at school and at home, whereas the estimate for NO₂ was attenuated. The authors conclude that traffic-related pollution exposure at school and home may both contribute to the development of asthma.

▼ NEWS | SCIENCE SELECTION

From Roadways to Wheeze: Child Asthma Associated with Traffic Exposures at Home and at School

ASTHMA/RESPIRATORY DISEASE AND LUNG DEVELOPMENT

Traffic-Related Particulate Matter and Acute Respiratory Symptoms among New York City Area Adolescents

Molini M. Patel, Steven N. Chillrud, Juan C. Correa, Yair Hazi, Marian Feinberg, Deepthi KC, Swati Prakash, James M. Ross, Diane Levy, and Patrick L. Kinney (September) 118:1338–1344.

Exposure to traffic-related particulate matter (PM) has been associated with adverse respiratory health outcomes in children. Although diesel exhaust particles (DEPs) are a local contributor to levels of urban fine PM [$\leq 2.5 \mu\text{m}$ in aerodynamic diameter (PM_{2.5})], evidence linking ambient DEP exposure to acute respiratory symptoms is relatively sparse. Patel et al. examined associations between daily concentrations of ambient black carbon (BC; an indicator of DEP) and daily respiratory symptoms among asthmatic and nonasthmatic adolescents in New York City and in a nearby suburban community. The authors found that increases in BC were associated with increased wheeze, shortness of breath, and chest tightness. Multiple lags of nitrogen dioxide (NO₂) exposure were associated with symptoms. For several symptoms, associations with BC and NO₂ were significantly larger in magnitude among urban subjects and asthmatics compared with suburban subjects and nonasthmatics, respectively, but PM_{2.5} was not consistently associated with increased symptoms. The authors conclude that acute exposures to traffic-related pollutants, such as DEPs and/or NO₂, may contribute to increased respiratory morbidity among adolescents and that urban residents and asthmatics may be at increased risk.



NEURODEVELOPMENTAL AND NEUROBEHAVIORAL DISORDERS

Using Systematic Reviews and Meta-Analyses to Support Regulatory Decision Making for Neurotoxicants: Lessons Learned from a Case Study of PCBs

Michael Goodman, Katherine Squibb, Eric Youngstrom, Laura Gutermuth Anthony, Lauren Kenworthy, Paul H. Lipkin, Donald R. Mattison, Judy S. LaKind (June) 118:727–734.

There is an extensive literature on the use and interpretation of neurodevelopmental tests to assess the effects of exposure to environmental agents. However, conclusions about causality are generally based on the weight of evidence (WOE) because even well-designed studies are subject to methodological limitations unavoidable in observational research. Goodman et al. examined prospective cohort studies that evaluated the relation between prenatal and neonatal exposure to polychlorinated biphenyls (PCBs) and neurodevelopment in children in order to assess the feasibility of conducting a meta-analysis to support decision making. The authors describe studies in terms of exposure and end point categorization, statistical analysis, and reporting of results. They used this evaluation to assess the feasibility of grouping studies into reasonably uniform categories. Their analyses indicate that the ability to conduct WOE assessments of the epidemiologic literature on neurotoxicants is limited—even in the presence of multiple studies—if the available study methods, data analysis, and reporting lack comparability. The authors conclude that there is a need to establish consensus standards for the conduct, analysis, and reporting of epidemiologic studies in general, and for those evaluating the effects of potential neurotoxic exposures in particular.

NEURODEVELOPMENTAL AND NEUROBEHAVIORAL DISORDERS

Lead Exposure and Behavior among Young Children in Chennai, India

Ananya Roy, David Bellingier, Howard Hu, Joel Schwartz, Adrienne S. Ettinger, Robert O. Wright, Maryse Bouchard, Kavitha Palaniappan, Kalpana Balakrishnan (October) 117:1607–1611.

Blood lead levels have decreased in Indian children since the phaseout of leaded gasoline in 2001, but levels continue to exceed acceptable limits in many areas. Effects of lead on IQ (intelligence quotient) scores are well established, but few studies have assessed effects on specific domains of behavior and cognition. Roy et al. conducted a cross-sectional study of 756 children 3–7 years of age in Chennai, India, to evaluate relations between blood lead levels and anxiety, social problems, inattention, hyperactivity, attention-deficit/hyperactivity disorder (ADHD), and executive function, which were assessed based on the Conners' Teacher Rating Scales-39, the Conners' ADHD/Diagnostic and Statistical Manual for Mental Disorders, 4th Edition Scales (CADS), and the Behavior Rating Inventory of Executive Function. The mean blood lead level in the study population was 11.4 µg/dL (range, 2.6–40.5 µg/dL), with more than half of the children having levels > 10 µg/dL. The authors report that blood lead level was associated with higher anxiety, social problems, ADHD, and deficits in executive function, and conclude that executive function and attention are particularly vulnerable to adverse neurobehavioral effects of lead.

NEURODEVELOPMENTAL AND NEUROBEHAVIORAL DISORDERS

Postnatal Cadmium Exposure, Neurodevelopment, and Blood Pressure in Children at 2, 5, and 7 Years of Age

Yang Cao, Aimin Chen, Jerilynn Radcliffe, Kim N. Dietrich, Robert L. Jones, Kathleen Caldwell, Walter J. Rogan (October) 117:1580–1586.

Epidemiologic studies conducted in the 1970s and 1980s reported evidence of adverse neurologic and developmental effects of cadmium, but results may have been confounded by other exposures (e.g., lead) or biased due to exposure misclassification. Cadmium has also been associated with hypertension in adults, but has not been evaluated as a risk factor for hypertension in children. Cao et al. analyzed data from the Treatment of Lead-Exposed Children (TLC) trial, a randomized clinical trial of succimer treatment in 2-year-old children with elevated blood lead levels (20–44 µg/dL) who were subsequently followed to 7 years of age. Blood cadmium levels were measured at 2 years, and blood pressure and neuropsychological and behavioral test scores were measured at 2, 5, and 7 years of age. The average cadmium concentration in study children was 0.21 µg/L, comparable to expectations based on a nationally representative sample. The authors report that blood cadmium levels at 2 years of age were not associated with neurodevelopmental end points or blood pressure at any of the time points assessed, either before or after accounting for blood lead levels, treatment group, and other potential confounders.

NEURODEVELOPMENTAL AND NEUROBEHAVIORAL DISORDERS

Exposure to Hydroxylated Polychlorinated Biphenyls (OH-PCBs) in the Prenatal Period and Subsequent Neurodevelopment in Eastern Slovakia

Hye-Youn Park, June-Soo Park, Eva Sovcikova, Anton Kocan, Linda Linderholm, Ake Bergman, Tomas Trnovec, Irva Hertz-Picciotto (October) 117:1600–1606.

Hydroxylated polychlorinated biphenyls (OH-PCBs) are water-soluble metabolites that may be actively transported across the placenta or formed by fetal metabolism. Experimental studies suggest effects on hormonal homeostasis and neurodevelopment, but health effects of OH-PCBs have not been studied in humans. Park et al. estimated associations of six OH-PCBs measured in maternal ($n = 147$) and cord ($n = 80$) serum samples with 16-month Bayley Scales of Infant Development Mental Development Index (MDI) and Psychomotor Development Index (PDI) scores. Study participants were a stratified random sample of cohort study participants from two eastern Slovakia sites, including an area with high environmental PCB contamination from a manufacturing facility. Cord and maternal serum levels of 4-OH-CB-107 were significantly associated with lower MDI scores, and cord 4-OH-CB-107 was also associated with lower PDI scores, but other OH-PCB metabolites were not associated with decreased test scores. The authors note that inverse associations were previously observed between Bayley Scores and levels of the parent PCBs from which 4-OH-CB-107 is derived, but conclude that results require confirmation in a larger study population.

NEURODEVELOPMENTAL AND NEUROBEHAVIORAL DISORDERS

Association of Traffic-Related Air Pollution with Children's Neurobehavioral Functions in Quanzhou, China

Shunqin Wang, Jinliang Zhang, Xiaodong Zeng, Yimin Zeng, Shengchun Wang, Shuyun Chen (October) 117:1612–1618.

Animal studies suggest that traffic-related air pollution may have adverse neurologic effects, but studies of neurobehavioral effects in children are limited. Wang et al. conducted a cross-sectional study of children from two primary schools in Quanzhou, China, to estimate associations between chronic exposure to ambient air pollution and neurobehavioral test scores. Participants were 8–10 years of age, including 431 children from a school in an area with low traffic density and 430 from a school in a high traffic area (median campus nitrogen dioxide concentrations of 7 $\mu\text{g}/\text{m}^3$ and 36 $\mu\text{g}/\text{m}^3$, respectively). The authors report that neurobehavioral test scores for children from the school with higher traffic-related air pollution exposure indicated poorer performance than scores for children with lower exposure, and conclude that additional studies are needed to clarify effects of traffic-related air pollution on neurobehavioral function and development.

NEURODEVELOPMENTAL AND NEUROBEHAVIORAL DISORDERS

Prenatal and Postnatal Tobacco Exposure and Behavioral Problems in 10-Year-Old Children: Results from the GINI-plus Prospective Birth Cohort Study

Simon Rückinger, Peter Rzehak, Chih-Mei Chen, Stefanie Sausenthaler, Sibylle Koletzko, Carl-Peter Bauer, Ute Hoffmann, Ursula Kramer, Dietrich Berdel, Andrea von Berg, Otmar Bayer, H.-Erich Wichmann, Rüdiger von Kries, Joachim Heinrich (January) 118:150–154.

Tobacco exposure has been associated with behavioral problems in children, but associations with exposures at specific time points have not been established. Rückinger et al. estimated associations between maternal smoking during pregnancy and/or tobacco smoke exposure during childhood with behavioral problems in 2,862 participants in the prospective German Infant Nutrition Intervention study. Exposure was assessed at birth and at periodic follow-up interviews (at least five per subject), and behavioral problems were identified based on parental responses to the Strength and Difficulties Questionnaire (SDQ) at the 10-year follow-up examination; children were classified as normal, borderline, or abnormal for emotional symptoms, conduct problems, hyperactivity/inattention, peer-relationship problems, and total difficulties according to standard SDQ cut points. Adjusted relative risks for abnormal total difficulty scores were increased among children exposed both prenatally and postnatally to tobacco smoke, with similar associations noted for conduct and hyperactivity/inattention subscales. The authors conclude that findings support adverse behavioral effects of tobacco smoke exposure in school-age children.

RELATED ARTICLES

EDITORIAL

Human Data on Bisphenol A and Neurodevelopment

Matthew P. Longnecker (December) 117:A531–A532.

NEURODEVELOPMENTAL AND NEUROBEHAVIORAL DISORDERS

Prenatal Bisphenol A Exposure and Early Childhood Behavior

Joe M. Braun, Kimberly Yolton, Kim N. Dietrich, Richard Hornung, Xiaoyun Ye, Antonia M. Calafat, Bruce P. Lanphear (December) 117:1945–1952.

Prenatal exposure bisphenol A (BPA) has been associated with behavioral changes in rodents, but associations with behavior in children have not been investigated. Braun et al. measured BPA concentrations in maternal urine at approximately 16 and 26 weeks of gestation and at birth, and evaluated behavior in the children at 2 years of age using the second edition of the Behavioral Assessment System for Children (BASC-2). Covariate-adjusted associations between maternal BPA concentrations and externalizing behavior scores (a composite of aggression and hyperactivity subscales), internalizing scores (depression, anxiety, and somatization subscales), and Behavior Symptom Index scores (aggression, hyperactivity, depression, and attention subscales) in 249 mother–child pairs were estimated using linear regression models. The authors report that prenatal BPA concentrations were similar to those reported for a representative sample of pregnant women in the United States, and that adjusted BPA concentrations at approximately 16 weeks of pregnancy were associated with higher externalizing scores among females but not among males. The authors note that additional research is needed to confirm their findings and to determine whether prenatal BPA is associated with behavior in older children.

NEURODEVELOPMENTAL AND NEUROBEHAVIORAL DISORDERS

Prenatal Exposure to Organohalogens, Including Brominated Flame Retardants, Influences Motor, Cognitive, and Behavioral Performance at School Age

Elise Roze, Lisette Meijer, Attie Bakker, Koenraad N.J.A. Van Braeckel, Pieter J.J. Sauer, Arend F. Bos (December) 117:1953–1958.

Organohalogen compounds (OHCs), including polychlorinated biphenyls (PCBs) and brominated diphenyl ether (PBDE) flame retardants, are persistent environmental pollutants. PCBs are established developmental neurotoxicants that have been associated with adverse neurodevelopmental outcomes in school-age children, but effects of prenatal PBDE exposures on these outcomes have not been assessed. Roze et al. analyzed data from 62 mothers and children enrolled in the prospective Groningen infant COMPARE study to estimate associations between 12 OHCs measured in maternal serum during the 35th week of pregnancy and motor performance (coordination, fine motor skills), cognition (intelligence, visual perception, visuomotor integration, inhibitory control, verbal memory, and attention), and behavior scores at 5–6 years of age. The authors report evidence of both positive and negative effects of exposures, including associations of PBDEs with worse fine manipulative ability and attention scores, and better coordination, visual perception, and behavior scores.

NEURODEVELOPMENTAL AND NEUROBEHAVIORAL DISORDERS

Prenatal Phthalate Exposure Is Associated with Childhood Behavior and Executive Functioning

Stephanie M. Engel, Amir Miodovnik, Richard L. Canfield, Chenbo Zhu, Manori J. Silva, Antonia M. Calafat, Mary S. Wolff (April) 118:565–571.

Experimental and observational studies have reported biological consequences of phthalate exposure relevant to neurodevelopment. Engel et al. examined the association of prenatal phthalate exposure with offspring behavior in a multiethnic prenatal population enrolled in the Mount Sinai Children's Environmental Health Study in New York City between 1998 and 2002. Third-trimester maternal urine samples were collected and analyzed for phthalate metabolites, and the cognitive and behavioral development of the children was assessed between the ages of 4 and 9 years. In multivariate adjusted models, increased \log_e concentrations of low-molecular-weight (LMW) phthalate metabolites were associated with poorer scores on the Aggression, Conduct Problems, Attention Problems, and Depression, and Externalizing Problems and Behavioral Symptom Index composite scales. Increased \log_e concentrations of LMW phthalates were also associated with poorer scores on the Global Executive Composite index and the Emotional Control scale. The authors note that behavioral domains adversely associated with prenatal exposure to LMW phthalates in this study are commonly affected in children clinically diagnosed with conduct or attention deficit hyperactivity disorders.

NEWS | SCIENCE SELECTION

Attention-Worthy Association: Prenatal Phthalate Exposure and Later Child Behavior

NEURODEVELOPMENTAL AND NEUROBEHAVIORAL DISORDERS

Polybrominated Diphenyl Ethers Induce Developmental Neurotoxicity in a Human *in Vitro* Model: Evidence for Endocrine Disruption

Timm Schreiber, Kathrin Gassmann, Christine Götz, Ulrike Hübenthal, Michaela Moors, Guido Krause, Hans F. Merk, Ngoc-Ha Nguyen, Thomas S. Scanlan, Josef Abel, Christine R. Rose, Ellen Fritsche (April) 118:572–578.

Levels of polybrominated diphenyl ethers (PBDEs)—persistent and bioaccumulative flame retardants—have been increasing in human tissues over the last several years. Although developmental exposure to PBDEs has been shown to cause behavioral alterations in rodent models, there is little information on the effects of PBDE exposure on neurodevelopment in humans. Schreiber et al. studied the *in vitro* effects of two prominent congeners found in human tissues, tetrabrominated BDE-47 and pentabrominated BDE-99, on proliferation, migration, and differentiation in primary fetal human neural progenitor cells (hNPCs). They also studied the potential involvement of thyroid disruption in the neurodevelopmental effects of the PBDEs. Over a range of noncytotoxic concentrations, PBDEs did not affect hNPC proliferation, but they reduced hNPC migration and affected neural differentiation in a concentration-dependent manner. Other experiments indicated that BDE-47 and BDE-99 affected migration and differentiation *in vitro* by endocrine disruption of cellular thyroid hormone signaling. These studies provide biological plausibility for *in vivo* animal studies reporting behavioral effects after developmental exposures, and they raise concerns about potential developmental neurotoxicity in humans.

NEWS | SCIENCE SELECTION

Brain Drain? PBDEs Alter Development of Human Brain Cells

NEURODEVELOPMENTAL AND NEUROBEHAVIORAL DISORDERS

Prenatal Exposure to PBDEs and Neurodevelopment

Julie B. Herbstman, Andreas Sjödin, Matthew Kurzon, Sally A. Lederman, Richard S. Jones, Virginia Rauh, Larry L. Needham, Deliang Tang, Megan Niedzwiecki, Richard Y. Wang, Frederica Perera (May) 118:712–719.

Polybrominated diphenyl ethers (PBDEs) are widely used flame retardant compounds that are persistent and bioaccumulative. Animal studies suggest that prenatal PBDE exposure may result in adverse neurodevelopmental effects. Herbstman et al. initiated a longitudinal cohort following the World Trade Center attack on 11 September 2001 to evaluate associations between concentrations of individual PBDE congeners and neurodevelopmental indices. Outcomes were evaluated in approximately 100 children with PBDE concentrations measured in cord blood samples. After adjustment for potential confounders, higher concentrations of BDEs 47, 99, or 100 were associated with lower scores on tests of mental and physical development at 12–48 and 72 months. The authors conclude that developmental exposure to flame retardants following the World Trade Center disaster was associated with altered neurodevelopment of children up to 72 months of age.

NEWS | SCIENCE SELECTION

An Inkling of Suspicion: Prenatal Exposure to PBDEs and Neurodevelopmental Impairment

NEURODEVELOPMENTAL AND NEUROBEHAVIORAL DISORDERS

Neurobehavioral Deficits and Increased Blood Pressure in School-Age Children Prenatally Exposed to Pesticides

Raul Harari, Jordi Julvez, Katsuyuki Murata, Dana Barr, David C. Bellinger, Frodi Debes, Philippe Grandjean (June) 118:890–896.

Long-term neurotoxicity risks resulting from prenatal exposures to pesticides are uncertain, but a previous study of Ecuadorian schoolchildren suggested that blood pressure and visuospatial processing may be vulnerable to these exposures. Harari et al. conducted a cross-sectional study of cardiovascular and neurobehavioral functions among 84 Ecuadorian children 6–8 years of age. Using an expanded battery of neurobehavioral tests, the investigators examined children in the two lowest grades in the local public school. Information on pesticide exposure during the index pregnancy was obtained from maternal interview, and each child's current pesticide exposure was assessed from the urinary excretion of organophosphate metabolites and erythrocyte acetylcholine esterase activity. Exposure-related deficits were the strongest for motor speed (Finger Tapping Task), motor coordination (Santa Ana Form Board), visuospatial performance (Stanford-Binet Copying Test), and visual memory (Stanford-Binet Copying Recall Test). According to the authors, these associations correspond to a developmental delay of 1.5–2 years. Prenatal pesticide exposure was also significantly associated with an increase in systolic blood pressure.

NEURODEVELOPMENTAL AND NEUROBEHAVIORAL DISORDERS

Relationship between Environmental Phthalate Exposure and the Intelligence of School-Age Children

Soo-Churl Cho, Soo-Young Bhang, Yun-Chul Hong, Min-Sup Shin, Boong-Nyun Kim, Jae-Won Kim, Hee-Jung Yoo, In Hee Cho, Hyo-Won Kim (July) 118:1027–1032.

Concern over phthalates has emerged because of their potential toxicity to humans, especially children. Cho et al. investigated the relationship between urinary concentrations of phthalate metabolites and children's intellectual functioning. The authors conducted a cross-sectional examination of urine phthalate concentrations in 621 children enrolled at elementary schools in five South Korean cities. Scores on neuropsychological tests were obtained from both the children and their mothers. Mono-2-ethylhexyl phthalate (MEHP) and mono(2-ethyl-5-oxohexyl) phthalate, both metabolites of di(2-ethylhexyl)phthalate (DEHP), and mono-*n*-butyl phthalate (MBP), a metabolite of dibutyl phthalate (DBP), were detected in urine samples. The Full-Scale IQ and Verbal IQ scores were negatively associated with the DEHP metabolites but not with MBP metabolites. There was also a significant inverse relationship between urine concentrations of DEHP and DBP metabolites and children's vocabulary subscores. Among boys, the authors noted an inverse association of MEHP phthalate concentrations and the sum of DEHP metabolite concentrations with the Wechsler Intelligence Scale for Children vocabulary score; however, significant associations with these variables were not observed in girls. The authors conclude that there is an inverse relationship between phthalate metabolites and IQ scores.



NEURODEVELOPMENTAL AND NEUROBEHAVIORAL DISORDERS

Prenatal Exposure to Airborne Polycyclic Aromatic Hydrocarbons and Children's Intelligence at 5 Years of Age in a Prospective Cohort Study in Poland

Susan Claire Edwards, Wieslaw Jedrychowski, Maria Butscher, David Camann, Agnieszka Kieltyka, Elzbieta Mroz, Elzbieta Flak, Zhigang Li, Shuang Wang, Virginia Rauh, and Frederica Perera (September) 118:1326–1331.

Polycyclic aromatic hydrocarbons (PAHs), such as benzo[*a*]pyrene, are released into ambient and indoor air from combustion sources (e.g., coal-burning power plants, diesel and gasoline-powered vehicles, home heating and cooking) and are present in tobacco smoke and charred foods. Edwards et al. studied the role of prenatal exposure to urban pollutants in the pathogenesis of neurobehavioral disorders in a prospective cohort study of Caucasian mothers and children in Krakow, Poland. The authors report that higher prenatal exposure to airborne PAHs was associated with decreased scores of non-verbal reasoning ability at 5 years of age. The reduction in nonverbal reasoning ability associated with high airborne PAH exposure corresponded to an estimated average decrease of 3.8 IQ points. The authors conclude that prenatal exposure to airborne PAHs adversely affects children's cognitive development by 5 years of age. These findings have potential implications for school performance.

CHILDHOOD LEUKEMIA

A Systematic Review and Meta-analysis of Childhood Leukemia and Parental Occupational Pesticide Exposure

Donald T. Wigle, Michelle C. Turner, Daniel Krewski (October) 117:1505–1513.

Childhood leukemias may develop from lymphoid or myeloid cells that acquire genetic abnormalities *in utero*. Known risk factors account for < 10% of cases, and exposure to ionizing radiation is the only established risk factor that is potentially modifiable. Parental pesticide exposure has been implicated based on experimental and epidemiologic research, and several common pesticides are considered probable or possible carcinogens. Wigle et al. report on a systematic literature review and meta-analysis of childhood leukemia and parental occupational exposure to pesticides based on 26 case-control and 5 cohort studies. The analysis did not indicate an association with paternal exposures, but did support an association with maternal occupational exposures based on all studies combined and study subgroups classified according to quality scores, farm-related exposures, and other characteristics. The authors suggest that results should be interpreted cautiously, but conclude that efforts to limit maternal exposures may be warranted.

CHILDHOOD LEUKEMIA

Residential Pesticides and Childhood Leukemia: A Systematic Review and Meta-Analysis

Michelle C. Turner, Donald T. Wigle, Daniel Krewski (January) 118:33–41.

Childhood leukemias, including acute lymphoblastic leukemia (ALL) and acute myelogenous leukemia (AML), are rare but potentially fatal cancers associated with substantial morbidity. Turner et al. report on a meta-analysis of original case-control or cohort studies of childhood leukemia and residential pesticide exposure or use. Eligible studies included 6 hospital-based and 10 population-based case-control studies, and one study with hospital- and population-based controls. The authors used random-effects models to generate summary odds ratios for childhood leukemia in association with ever versus never exposure to pesticides, insecticides, or herbicides during preconception, pregnancy, or childhood. Heterogeneity among studies varied depending on the specific exposure being evaluated, but was substantial in some cases. The authors report positive associations with exposures during pregnancy to pesticides, insecticides, and herbicides, and positive associations with childhood exposures to pesticides and insecticides, but note that additional research is needed to confirm findings and investigate dose-response relations and specific pesticides.

CANCER

Childhood Brain Tumors, Residential Insecticide Exposure, and Pesticide Metabolism Genes

Susan Searles Nielsen, Roberta McKean-Cowdin, Federico M. Farin, Elizabeth A. Holly, Susan Preston-Martin, Beth A. Mueller (January) 118:144–149.

Established risk factors for childhood brain tumors (CBTs) are limited to ionizing radiation and rare heritable syndromes, but studies have reported some evidence of associations with insecticide exposures. Searles Nielsen et al. hypothesized that susceptibility might be increased in children with gene polymorphisms relevant to insecticide metabolism, including *PON1*_{C-108T}, *PON1*_{Q192R}, *PON1*_{L55M}, *BCHE*_{A539T}, *FMO1*_{C-9536A}, *FMO3*_{E158K}, *ALDH3A1*_{S134A}, and *GSTT1* (null). DNA was extracted from archival screening samples for 201 cases and 285 population-based controls ≤ 10 years of age and born in California or Washington State between 1978 and 1990. Insecticide exposures during pregnancy and childhood were classified based on interviews with participants' mothers. The authors report that numbers of variant alleles (0, 1, or 2) or the presence (versus absence) of the *GSTT1* null genotype were not associated with CBT based on adjusted odds ratios, but they observed multiplicative interactions between insecticide exposure during childhood (any versus none) and variant alleles of *PON1*_{C-108T}, *FMO1*_{C-9536A}, and *BCHE*_{A539T}. Results need to be confirmed in other study populations, but the authors conclude that findings are consistent with increased risks of CBT among children with a reduced capacity to detoxify insecticides.

NEWS | SCIENCE SELECTION

Critical Confluence: Gene Variants, Insecticide Exposure May Increase Childhood Brain Tumor Risk

BIRTH DEFECTS

Chlorination Disinfection By-Products in Drinking Water and Congenital Anomalies: Review and Meta-Analyses

Mark J. Nieuwenhuijsen, David Martinez, James Grellier, James Bennett, Nicky Best, Nina Iszatt, Martine Vrijheid, Mireille B. Toledano (October) 117:1486–1493.

Water disinfection has substantial public health benefits, but also results in widespread exposure to chlorination disinfection by-products (DBPs) that have been inconsistently associated with congenital anomalies. Nieuwenhuijsen et al. conducted a meta-analysis of existing studies to summarize current evidence and determine needs for future research. The authors included all published epidemiologic studies of DBP exposure (based on type of treatment, water source, or DBP measurements) and congenital anomalies, and derived summary estimates and dose–response estimates when appropriate. High versus low exposure to water chlorination or total trihalomethane concentrations was associated with all congenital anomalies combined [17%; 95% confidence interval (CI), 3–34] and with ventricular septal defects specifically (58%; 95% CI, 21–107), but the authors note that both estimates were based on small numbers of studies. They conclude that exposure classification and outcome ascertainment must be optimized and that additional DBPs and DBP mixtures should be evaluated in future research.

▼ NEWS | SCIENCE SELECTION

Disinfection By-Products and Congenital Anomalies: Evidence Still Inconclusive

BIRTH DEFECTS

Anogenital Distance from Birth to 2 Years: A Population Study

Ajay Thankamony, Ken K. Ong, David B. Dunger, Carlo L. Acerini, Ieuan A. Hughes (November) 117:1786–1790.

Anogenital distance (AGD), a sexually dimorphic trait in rodents and humans, is considered a reliable marker of androgen and antiandrogen effects in rodents, but data on AGD in humans are sparse, and longitudinal changes during infancy have not been assessed. Thankamony et al. measured AGD in 463 male and 426 female full-term infants living in the United Kingdom and assessed changes over time based on 2,168 longitudinal AGD measurements (median of two measurements per infant). The authors suggest that these findings may be used as normative data for population studies of effects of environmental chemicals on genital development.

RELATED ARTICLES

NEWS | FORUM

Conference, Hearing Call Up Cell Phone Use

Kellyn S. Betts (November) 117:A486.



NEWS | FORUM

First Combined Analysis from INTERPHONE Inconclusive

Kellyn S. Betts (July) 118:A290–A291.

NEWS | FORUM

Childhood Leukemia and Proximity to Nuclear Power Plants

Adrian Burton (October) 117:A437.

PODCAST | A RESEARCHER'S PERSPECTIVE

Do PCBs Contribute to Childhood Leukemia?

with Mary H. Ward (28 July 2009)

Incidence of acute lymphocytic leukemia, the most common childhood leukemia, is highest in industrialized countries and rose significantly between 1975 and 2004, suggesting environmental agents may play some role.

PREGNANCY OUTCOMES: PRETERM BIRTH, SMALL FOR GESTATIONAL AGE, FETAL DEVELOPMENT

Urinary Phthalate Metabolites in Relation to Preterm Birth in Mexico City

John D. Meeker, Howard Hu, David E. Cantonwine, Hector Lamadrid-Figueroa, Antonia M. Calafat, Adrienne S. Ettinger, Mauricio Hernandez-Avila, Rita Loch-Caruso, Martha María Téllez-Rojo (October) 117:1587–1592.

Previous studies have reported inconsistent associations between gestational age and phthalates, which are commonly used in personal care products, pharmaceuticals, and plastics manufacturing. Meeker et al. conducted a nested case–control study within a Mexican birth cohort comparing third-trimester urinary phthalate metabolite concentrations between 30 women who delivered preterm (< 37 weeks gestation) and 30 controls. The authors report that geometric mean urinary concentrations of several phthalate metabolites were higher among cases than controls, and that differences were attenuated but still apparent after correcting for urine dilution. Cases were also more likely than controls to have urinary phthalate metabolite concentrations above median levels based on logistic regression models adjusted for potential confounders. The authors note that concentrations of some phthalate metabolites were elevated in the population compared with previous estimates for women in the United States, and suggest that additional research is needed to identify exposure sources and confirm findings in a larger study population.

PREGNANCY OUTCOMES: PRETERM BIRTH, SMALL FOR GESTATIONAL AGE, FETAL DEVELOPMENT

Drinking-Water Herbicide Exposure in Indiana and Prevalence of Small-for-Gestational-Age and Preterm Delivery

Hugo Ochoa-Acuña, Jane Frankenberger, Leighanne Hahn, Cristina Carbajo (October) 117:1619–1624.

Atrazine and other corn herbicides are routinely detected in drinking water. Two studies on atrazine's potential association with small-for-gestational-age (SGA) and preterm birth prevalence have found inconsistent results. Moreover, these studies did not control for individual-level potential confounders. Ochoa-Acuña et al. used a retrospective cohort study to evaluate whether atrazine in drinking water is associated with increased prevalence of SGA and preterm birth. They found that atrazine in drinking water during the third trimester, as well as during the entire pregnancy, was associated with a significant increase in the prevalence of SGA. Levels of atrazine > 0.1 µL in drinking water during the third trimester were associated with a 17–19% increase in the prevalence of SGA. Mean atrazine concentrations over the entire pregnancy > 0.644 µg/L also were associated with higher SGA prevalence. No association was found for preterm delivery.

PREGNANCY OUTCOMES: PRETERM BIRTH, SMALL FOR GESTATIONAL AGE, FETAL DEVELOPMENT

Association between Local Traffic-Generated Air Pollution and Preeclampsia and Preterm Delivery in the South Coast Air Basin of California

Jun Wu, Cizao Ren, Ralph J. Delfino, Judith Chung, Michelle Wilhelm, Beate Ritz (November) 117:1773–1779.

Preeclampsia, a major cause of maternal and perinatal morbidity and mortality, complicates 2–8% of pregnancies. Evidence of adverse effects of air pollution on pregnancy outcomes has been reported, but effects of traffic-related pollutants have not been studied extensively, despite the potential for greater toxicity and spatial variation in exposure. Wu et al. examined preeclampsia and preterm delivery (< 37 weeks gestation) in association with residential exposure to traffic-generated nitrogen oxides (NO_x) and particulate matter ≤ 2.5 µm in aerodynamic diameter (PM_{2.5}) among 81,186 singleton births in California, with exposures over the entire pregnancy estimated using a line-source dispersion model (CALINE4). Preeclampsia was increased among women in the highest versus lowest quartile range of NO_x [adjusted odds ratio (OR) = 1.33; 95% CI, 1.18–1.49] and PM_{2.5} exposures (OR = 1.42; 95% CI, 1.26–1.59); preterm births, particularly births < 30 weeks gestation, were also associated with these exposures (NO_x OR = 2.28; 95% CI, 2.15–2.42 and PM_{2.5} OR = 1.81; 95% CI, 1.71–1.92). The authors conclude that results provide further support for adverse effects of air pollution on reproductive outcomes.

▼ NEWS | SCIENCE SELECTION

Delivering New Data: Local Traffic Pollution and Pregnancy Outcomes

PREGNANCY OUTCOMES: PRETERM BIRTH, SMALL FOR GESTATIONAL AGE, FETAL DEVELOPMENT

Residential Exposure to Traffic and Spontaneous Abortion

Rochelle S. Green, Brian Malig, Gayle C. Windham, Laura Fenster, Bart Ostro, Shanna Swan (December) 117:1939–1944.

Air pollution and traffic exposure have been associated with adverse birth outcomes, but few studies have examined associations with spontaneous abortion (SAB). Green et al. analyzed data from 4,979 participants in the Kaiser Pregnancy Outcomes Study cohort, a longitudinal study of women in a prepaid health care plan in California that were enrolled into the study during the first 13 weeks of pregnancy. Traffic exposure was estimated according to each woman's residence in early pregnancy based on annual average daily traffic (AADT) counts and distance to major roads; data on potential confounders and effect modifiers were collected at enrollment. Outcomes were ascertained from hospital admission files and medical records, including SAB (≤ 20 weeks of pregnancy, *n* = 499), stillbirths (fetal deaths after 20 weeks, *n* = 32), and live births (*n* = 4,613). The authors report that living within 50 m of a road with AADT at or above the 90th percentile for the study population was significantly associated with SAB among African Americans and nonsmokers, with evidence of synergistic interactions of traffic with race and nonsmoking status. The authors recommend additional research to confirm their findings and clarify underlying mechanisms.

PREGNAVY OUTCOMES: PRETERM BIRTH, SMALL FOR GESTATIONAL AGE, FETAL DEVELOPMENT

Transcriptional Biomarkers of Steroidogenesis and Trophoblast Differentiation in the Placenta in Relation to Prenatal Phthalate Exposure

Jennifer J. Adibi, Robin M. Whyatt, Russ Hauser, Hari K. Bhat, Barbara J. Davis, Antonia M. Calafat, Lori A. Hoepner, Frederica P. Perera, Deliang Tang, Paige L. Williams (February) 118:291–296.

Epidemiologic studies have reported both positive and inverse associations between *in utero* exposure to phthalates (synthetic compounds widely used in manufacturing) and pregnancy duration. In addition, the phthalate metabolite DEHP has been shown to activate a key regulator of placental development and function, peroxisome proliferator-activated receptor gamma (PPAR γ), in rat placenta. Adibi et al. studied phthalate metabolite concentrations in maternal urine (collected during the third trimester) and target gene expression in placenta tissue obtained at delivery from 54 African-American and Dominican study participants, including genes involved in steroidogenesis (aromatase, cholesterol side chain cleavage enzyme, 17 β -hydroxysteroid dehydrogenase type 1, and cytochrome P450 1B1 genes) and genes involved in trophoblast differentiation (PPAR γ , aryl hydrocarbon receptor, and human chorionic gonadotropin genes). The authors report that higher urinary concentrations of phthalate metabolites were associated with reduced expression of genes involved in trophoblast differentiation, but exposures were not clearly associated with steroidogenesis gene expression. The authors recommend additional studies to clarify the implications of their findings for fetal development and placental function.

PREGNAVY OUTCOMES: PRETERM BIRTH, SMALL FOR GESTATIONAL AGE, FETAL DEVELOPMENT

Maternal Serum Preconception Polychlorinated Biphenyl Concentrations and Infant Birth Weight

Laurel E. Murphy, Audra L. Gollenberg, Germaine M. Buck Louis, Paul J. Kostyniak, Rajeshwari Sundaram (February) 118:297–302.

Polychlorinated biphenyl (PCBs) levels measured in maternal blood during or after pregnancy have been inversely associated with infant birth weights, but potential effects of preconception PCB exposures have not been assessed. Murphy et al. measured 76 PCB congeners in serum samples from 52 women who became pregnant within 12 months of enrollment in the study and subsequently completed a live birth, including preconceptional levels in samples collected at enrollment, prenatal levels at approximately 6 weeks of gestation, and postnatal levels approximately 6 weeks after delivery. The authors report that total PCBs were higher in preconceptional serum samples than in prenatal samples and that children born to women with preconceptional levels of antiestrogenic PCBs in the highest tertile of the cohort distribution weighed 429 g less at birth, on average, than children born to mothers with levels in the lowest tertile (based on linear regression model estimates adjusted for the child's sex and maternal height and smoking). The authors conclude that the preconceptional period may be a sensitive time window for effects of PCBs on development, and suggest that results highlight the importance of evaluating PCB congener subgroups classified according to putative biologic mechanisms.

RELATED ARTICLES

NEWS | FOCUS

Environmental Factors in Birth Defects: What We Need to Know

Bob Weinhold (October) 117:A441–A447.



NEWS | FORUM

Examining DDT's Urogenital Effects

Naomi Lubick (January) 118:A18.

PODCAST | A RESEARCHER'S PERSPECTIVE

Phthalate Research Coming of Age?

with Shanna Swan (12 June 2009)

In 2005 Shanna Swan and colleagues published groundbreaking research [*EHP* 113:1056-1061 (2005)] linking mothers' phthalate levels with altered genital development in their baby sons. This paper later became *EHP*'s 2009 Paper of the Year.

PREGNANCY OUTCOMES: PRETERM BIRTH, SMALL FOR GESTATIONAL AGE, FETAL DEVELOPMENT

Environmental Levels of *para*-Nonylphenol Are Able to Affect Cytokine Secretion in Human Placenta

Nicoletta Bechi, Francesca Ietta, Roberta Romagnoli, Silke Jantra, Marco Cencini, Gianmichele Galassi, Tommaso Serchi, Ilaria Corsi, Silvano Focardi, Luana Paulesi (March) 118:427–431.

para-Nonylphenol (*p*-NP), a by-product of alkylphenol compounds widely used in the chemical industry and manufacturing, has been shown to bind to estrogen receptors and induce proliferation of estrogen-sensitive MCF-7 breast cancer cells *in vitro*. Bechi et al. previously reported that maternal exposure to *p*-NP induced expression of a marker of estrogenic activity in maternal and neonatal tissues in rats, consistent with transfer of *p*-NP across the placenta. In this article the authors report on *in vitro* effects of *p*-NP on cytokine secretion in cultured chorionic villous explants from human placentas. The authors report that cytokine release appeared to be influenced by *p*-NP exposures, with evidence of increased release of granulocyte-macrophage colony-stimulating factor (GM-CSF), interferon- γ (IFN- γ), interleukin (IL)-1 β , IL-4, and IL-10 (maximum effects at 10–11 M), and decreased release of tumor necrosis factor- α (TNF- α) at 10–13 M. The authors note that placental development is controlled in part by the balance of cytokines at the maternal–fetal interface and conclude that evidence of effects of *p*-NP on placental cytokines at levels consistent with environmental exposures should raise concerns about maternal exposures during pregnancy.

PREGNANCY OUTCOMES: PRETERM BIRTH, SMALL FOR GESTATIONAL AGE, FETAL DEVELOPMENT

Barrier Capacity of Human Placenta for Nanosized Materials

Peter Wick, Antoine Malek, Pius Manser, Danielle Meili, Xenia Maeder-Althaus, Liliane Diener, Pierre-Andre Diener, Andreas Zisch, Harald F. Krug, Ursula von Mandach (March) 118:433–436.

Gold nanoparticles have been reported to cross the placenta after maternal intravenous injection in rats, but structural and physiologic differences across species preclude inferences about the ability of nanoparticles to cross human placentas based on animal studies. Wick et al. used an *ex vivo* human placental perfusion model to study the transfer of fluorescent polystyrene particles (nominal diameters of 50, 80, 240, and 500 nm) across the placenta. The authors report that polystyrene particles up to 240 nm in diameter were able to cross the placental barrier without affecting the viability of the placental explant. The authors conclude that findings are consistent with size-dependent transfer of nanomaterials across human placentas, but they acknowledge that the model involved high-dose exposures over a period of a few hours and that the perfusion rate was representative of placental perfusion late in pregnancy. In addition, they suggest that transfer may also be influenced by particle composition or surface coatings, thus preventing generalization across different types of nanoparticles.

PREGNANCY OUTCOMES: PRETERM BIRTH, SMALL FOR GESTATIONAL AGE, FETAL DEVELOPMENT

Interaction between *GSTM1/GSTT1* Polymorphism and Blood Mercury on Birth Weight

Bo-Eun Lee, Yun-Chul Hong, Hyesook Park, Mina Ha, Bon Sang Koo, Namsoo Chang, Young-Man Roh, Boong-Nyun Kim, Young-Ju Kim, Byung-Mi Kim, Seong-Joon Jo, Eun-Hee Ha (March) 118:437–443.

Epidemiologic studies have reported associations between mercury (Hg) exposure and a variety of adverse reproductive outcomes, but associations between Hg and birth weight have been inconsistent. Lee et al. hypothesized that inconsistent findings might reflect variation in genetic susceptibility among study populations, including variation in the prevalence of glutathione S-transferase M1 (*GSTM1*) and *GSTT1* null polymorphisms that may reduce Hg clearance and increase oxidative stress secondary to Hg exposure. The authors measured total Hg concentrations in maternal and cord blood from 417 Korean women and newborns enrolled in the Mothers and Children's Environmental Health study, identified *GSTM1* and *GSTT1* null genotypes in the mothers, and obtained birth weight data from medical records. The authors report that Hg concentration in maternal blood during late pregnancy was inversely associated with birth weight among women with the *GSTT1* null genotype, and that maternal and cord blood Hg concentrations were both inversely associated with birth weight among mothers with combined *GSTM1* null and *GSTT1* null genotypes. They conclude that *GSTM1* and *GSTT1* polymorphisms may influence susceptibility to effects of Hg on birth weight.

PREGNANCY OUTCOMES: PRETERM BIRTH, SMALL FOR GESTATIONAL AGE, FETAL DEVELOPMENT

Prenatal Exposure to Traffic-Related Air Pollution and Ultrasound Measures of Fetal Growth in the INMA Sabadell Cohort

Inmaculada Aguilera, Raquel Garcia-Esteban, Carmen Iñiguez, Mark J. Nieuwenhuijsen, Águeda Rodríguez, Montserrat Paez, Ferran Ballester, Jordi Sunyer (May) 118:705–711.

Numerous studies have reported that traffic-related air pollution is associated with intrauterine growth restriction, low birth weight, and preterm birth, but studies to determine the most harmful pollutants and the most susceptible periods for exposure have been inconclusive. Aguilera et al. studied exposure to nitrogen dioxide (NO₂) and aromatic hydrocarbons in association with fetal growth among 562 pregnant women in the Spanish INMA Sabadell study cohort. Exposure to aromatic hydrocarbons during early pregnancy was inversely associated with growth in biparietal diameter during weeks 20–32, but none of the other fetal growth parameters were associated with exposure to air pollution during pregnancy. Associations were stronger among women who spent < 2 hr/day in nonresidential outdoor locations, resulting in statistically significant associations between NO₂ and growth in head circumference during weeks 12–20 and growth in abdominal circumference, biparietal diameter, and estimated fetal weight during weeks 20–32. The authors conclude that exposure to traffic-related air pollutants during early pregnancy may affect fetal growth during mid-pregnancy.

PREGNANCY OUTCOMES: PRETERM BIRTH, SMALL FOR GESTATIONAL AGE, FETAL DEVELOPMENT

PBDE Concentrations in Women's Serum and Fecundability

Kim G. Harley, Amy R. Marks, Jonathan Chevrier, Asa Bradman, Andreas Sjödin, Brenda Eskenazi (May) 118:699–704.

Polybrominated diphenyl ethers (PBDEs) are flame retardants used in furniture, carpeting, textiles, electronics, and plastics to reduce the risk of ignition and slow burning. PBDEs have been associated with reproductive and hormonal effects in animals, but there is limited information concerning potential effects on fertility in humans. Harley et al. studied associations between maternal concentrations of serum PBDEs during pregnancy and time to pregnancy and menstrual cycle characteristics among 223 women from a predominantly Mexican-immigrant community in California. The authors report that all four PBDE congeners measured (BDEs 47, 99, 100, 153) were detected in more than 95% of the women studied. Fecundability odds ratios were inversely associated with BDE-100, BDE-153, and the sum of the four congeners, indicating that higher exposures were associated with a longer time to pregnancy. PBDE concentrations were not associated with menstrual cycle characteristics. The authors conclude that PBDE exposure is associated with decreased fecundability in women.

NEWS | SCIENCE SELECTION

Pregnant Pause: Does Maternal PBDE Exposure Extend Time to Pregnancy

IMMUNE-BASED DISEASE

Breaking Patterns of Environmentally Influenced Disease for Health Risk Reduction: Immune Perspective

Rodney R. Dietert, Jamie C. DeWitt, Dori R. Germolec, Judith T. Zelikoff (August) 118:1091–1099.

Environmentally related diseases rarely, if ever, occur in isolation. Instead, most represent part of a more complex web or pattern of conditions that are connected via underlying biological mechanisms and processes and that emerge across a lifetime. Dietert et al. describe how an understanding of patterns of disease may be used to develop new strategies for reducing the prevalence and risk of major immune-based illnesses and diseases influenced by environmental agents. These authors note that patterns of disease that begin in childhood include not only metabolic syndrome but also allergic, autoimmune, recurrent infection, and other inflammatory patterns of disease. Recent identification of major immune-based disease patterns beginning in childhood suggests that the immune system may play an even more important role in determining health status and health care needs across a lifetime than was previously thought. Focusing on patterns of disease, as opposed to individual conditions, offers two important venues for environmental health risk reduction: a) Prevention of developmental immunotoxicity and pediatric immune dysfunction, for example, can be used to mitigate a number of other diseases; and b) pattern-based treatment of entryway diseases can also be tailored with the aim of disrupting the entire disease pattern and reducing the risk of later-life illnesses connected to underlying immune dysfunction. Disease pattern-based evaluation, prevention, and treatment will require a change from the current approach for both immune safety testing and pediatric disease management.

NEWS | SCIENCE SELECTION

Breaking Patterns of Disease: Early-Life Clues May Predict Long-Term Health

AUTISM

Blood Mercury Concentrations in CHARGE Study Children with and without Autism

Irva Hertz-Picciotto, Peter G. Green, Lora Delwiche, Robin Hansen, Cheryl Walker, Isaac N. Pessah (January) 118:161–166.

Mercury (Hg) has been investigated as a possible cause of autism, but its association with autism remains uncertain. Hertz-Picciotto et al. examined blood Hg levels and sources of Hg exposure among participants in the Childhood Autism Risk from Genetics and the Environment (CHARGE) Study, including 2- to 5-year-old children classified as having autism or an autism spectrum disorder (autism/ASD, $n = 249$), developmental delay (DD, $n = 60$), and typical development (TD population-based controls, $n = 143$) based on standardized criteria and clinical examination. Information on household, medical, and dietary exposures was provided by mothers, and blood Hg was measured by inductively coupled plasma mass spectrometry. Fish consumption strongly predicted blood Hg, and lower average blood Hg levels observed in the autism/ASD group were consistent with lower levels of fish consumption in autism/ASD children compared with TD controls. In addition, multiple linear regression model predictions indicated comparable blood Hg levels in autism/ASD and TD children when adjusted for differences in fish consumption. Lower blood Hg levels observed in all analyses for children with DD versus TD or autism/ASD may have been a chance finding, but the authors propose that metabolic differences should also be investigated. The authors also note that findings do not rule out an effect of early Hg exposure on the etiology of autism/ASD because associations were measured after diagnosis.

FETAL OR EARLY-LIFE EXPOSURES CONTRIBUTING TO ADULT DISEASE

Association of Intrauterine and Early-Life Exposures with Diagnosis of Uterine Leiomyomata by 35 Years of Age in the Sister Study

Aimee A. D’Aloisio, Donna D. Baird, Lisa A. DeRoo, Dale P. Sandler (March) 118:375–381.

Uterine leiomyomata (fibroids) are the most common indication for hysterectomies in the United States, but underlying causes of these hormonally responsive benign smooth muscle tumors have not been identified. D’Aloisio et al. hypothesized that early-life exposures that affect uterine development and hormone responses later in life might contribute to fibroid pathogenesis. The authors estimated associations between early fibroid diagnoses (diagnosed by health professional before 36 years of age) among 19,972 non-Hispanic white participants in the Sister Study who were 35–59 years old at enrollment. Early fibroid diagnoses were reported by 8% of study participants, consistent with previous estimates. Adjusted risk ratio estimates (from log-binomial regression models) indicated increased relative risks in association with being fed soy formula during infancy, maternal prepregnancy diabetes, low childhood socioeconomic status, and early birth (at least 1 month before the due date). *In utero* diethylstilbestrol (DES) exposure was also associated with early fibroid diagnosis, but only among women reporting probable (versus definite) DES exposure. The authors conclude that effects of early life exposures on uterine fibroid pathogenesis are biologically plausible, but note that findings need to be replicated in other study populations.

NEWS | SCIENCE SELECTION

From One Womb to Another: Early Estrogenic Exposures and Later Fibroid Risk

FETAL OR EARLY-LIFE EXPOSURES CONTRIBUTING TO ADULT DISEASE

Exposure to Asbestos-Containing Vermiculite Ore and Respiratory Symptoms among Individuals Who Were Children While the Mine Was Active in Libby, Montana

Lisa C. Vinikoor, Theodore C. Larson, Thomas F. Bateson, Linda Birnbaum (July) 118:1033–1038.

The largest vermiculite ore mine in the United States, located in Libby, Montana, was closed in 1990. The processing, use, and transport of the ore, which was contaminated with amphibole asbestos, led to generalized contamination of the community. Vinikoor et al. examined the prevalence of respiratory symptoms in 2000–2001 and their association with history of vermiculite exposure among 1,003 area residents ≤ 18 years of age when the mine closed. Information on respiratory symptoms and exposure history was collected by questionnaire in 2000–2001, at which time participants were 10–29 years of age. Respiratory symptoms such as usually having a cough, experiencing shortness of breath when walking up a slight hill or hurrying on level ground, and having coughed up bloody phlegm in the past year were positively associated with frequently handling vermiculite insulation. The authors found no association between vermiculite insulation in houses and respiratory symptoms of residents. Respiratory symptoms were also associated with other vermiculite exposures, and the number and frequency of these activities showed a positive trend with usually having a cough. However, these exposures were not associated with abnormal spirometry. The authors conclude that residents who were children when the mine closed experienced respiratory symptoms associated with asbestos-contaminated vermiculite exposure.

HORMONAL DEVELOPMENT

Investigation of Relationships between Urinary Biomarkers of Phytoestrogens, Phthalates, and Phenols and Pubertal Stages in Girls

Mary S. Wolff, Susan L. Teitelbaum, Susan M. Pinney, Gayle Windham, Laura Liao, Frank Biro, Lawrence H. Kushi, Chris Erdmann, Robert A. Hiatt, Michael E. Rybak, Antonia M. Calafat, Breast Cancer (July) 118:1039–1046.

Hormonally active environmental agents may alter the course of pubertal development in girls, which is controlled by endogenous steroids and gonadotropins. Wolff et al. investigated associations of concurrent exposures from three chemical classes—phenols, phthalates, and phytoestrogens—with pubertal stages in a multiethnic longitudinal study of 1,151 girls from three regions of the United States; participants were 6–8 years of age at enrollment. The authors measured exposure biomarkers in urine samples at the first visit, and they examined associations with breast and pubic hair development 1 year later. Modification of biomarker associations by age-specific body mass index percentile (BMI%) was also investigated. High-molecular-weight phthalate (MWP) metabolites were weakly associated with pubic hair development. The authors observed small inverse associations between daidzein and breast stage, and for triclosan and high MWP with pubic hair development. They reported a positive trend for low-molecular-weight phthalate biomarkers with breast and pubic hair development. Enterolactone attenuated BMI associations with breast development. The authors conclude that weak hormonally active xenobiotic agents had small associations with pubertal development, mainly among those agents detected at the highest concentrations.

HORMONAL DEVELOPMENT

Goitrogenic Anions, Thyroid-Stimulating Hormone, and Thyroid Hormone in Infants

Yang Cao, Benjamin C. Blount, Liza Valentin-Blasini, Judy C. Bernbaum, Terry M. Phillips, and Walter J. Rogan (August) 118:1332–1337.

Environmental exposure of infants to perchlorate, thiocyanate, and nitrate might interfere with thyroid function. U.S. women with higher background perchlorate exposure have higher thyroid-stimulating hormone (TSH) levels and lower thyroxine (T₄) levels, but no studies have reported individual measures of thyroid function and these goitrogens in infants. Using data and samples from the Study of Estrogen Activity and Development, which assessed hormone levels of full-term infants during the first 12 months of life, Cao et al. examined the association between urinary perchlorate, nitrate, and thiocyanate with urinary T₄ and TSH in infants and whether that association differed by sex or iodide status. Infants with higher urinary perchlorate, nitrate, or thiocyanate reportedly had higher urinary TSH. Children with higher nitrate and thiocyanate had higher TSH, but higher perchlorate was associated with TSH only in children with low iodide. Unexpectedly, exposure to the three chemicals was generally associated with higher T₄. The authors conclude that perchlorate exposure is associated with increased urinary TSH in infants with low urinary iodide. Higher thiocyanate and nitrate exposure were also associated with higher TSH in infants.

RELATED ARTICLES

NEWS | FORUM

Parental Smoking May Set Up Children for Atherosclerosis

Adrian Burton (May) 118:A200.



PODCAST | A RESEARCHER'S PERSPECTIVE

Studying Autism and Mercury

with Irva Hertz-Picciotto (1 February 2010)

Some research suggests environmental factors play a role in autism, while other findings point to a genetic basis. More recently there's been a heated public debate about whether autism is caused by the mercury in vaccines commonly given to children.

PODCAST | A RESEARCHER'S PERSPECTIVE

Delayed Reaction: The Fetal Basis of Adult Disease

with Deborah Cory-Slechta (1 July 2010)

Exposures *in utero* can cause immediate health problems for fetuses and babies, but what about diseases that typically arise later in life, such as heart disease and cancer? Could some of these also result from prenatal exposures?

Exposures

HEAVY METALS

Maternal Blood Lead Levels and the Risk of Pregnancy-Induced Hypertension: The EDEN Cohort Study

Chadi Yazbeck, Olivier Thiebaugeorges, Thierry Moreau, Valérie Goua, Ginette Debotte, Josiane Sahuquillo, Anne Forhan, Bernard Foliquet, Guillaume Magnin, Rémy Slama, Marie-Aline Charles, Guy Huel (October) 117:1526–1530.

Blood lead level (BLL) is positively associated with hypertension, and previous epidemiologic studies have reported associations between late-pregnancy BLL and pregnancy-induced hypertension (PIH), an important cause of maternal and neonatal morbidity. Yazbeck et al. studied PIH and maternal BLL measured at 24–28 weeks of gestation among 971 women in the EDEN (European Day Hospital Evaluation) cohort study. Blood pressure was measured during routine monthly visits, and women with elevated systolic or diastolic blood pressure at two or more visits were classified as having PIH ($n = 106$). The authors report that blood lead was positively associated with PIH, with a monotonic dose response from the lowest ($< 1.2 \mu\text{g/dL}$) to highest (> 2.3 – $8.5 \mu\text{g/dL}$) quartile and an adjusted odds ratio of 3.3 (95% confidence interval, 1.1–9.7) for each $1\text{-}\mu\text{g/dL}$ increase in BLL. The authors conclude that lead levels well below the commonly accepted upper limit of $10 \mu\text{g/dL}$ may increase the risk of PIH.

HEAVY METALS

Mass Lead Intoxication from Informal Used Lead-Acid Battery Recycling in Dakar, Senegal

Pascal Haefliger, Monique Mathieu-Nolf, Stephanie Locicero, Cheikh Ndiaye, Malang Coly, Amadou Diouf, Absa Lam Faye, Aminata Sow, Joanna Tempowski, Jenny Pronczuk, Antonio Pedro Filipe Junior, Roberto Bertolini, Maria Neira (October) 117:1535–1540.

Haefliger et al. describe an investigation prompted by the unexplained deaths of 18 children in the NGagne Diaw suburb of Dakar, Senegal. From 1995 to 2008 many NGagne Diaw residents were involved in lead-acid battery recycling, including manually recovering lead particles from contaminated soil. Clinical and laboratory assessments were performed on 32 siblings and 23 mothers of deceased children and on 18 unrelated children and 8 adults from the area, and lead contamination was measured in soil and homes. Mean blood lead levels were $129.5 \mu\text{g/dL}$ (range, 39.8 – $613.9 \mu\text{g/dL}$) in children and $55.5 \mu\text{g/dL}$ (range, 32.5 – $98.8 \mu\text{g/dL}$) in adults. Seventeen children had clinical signs of severe toxicity, and homes and soil were heavily contaminated with lead. The authors conclude that most if not all of the deaths resulted from severe lead intoxication, which may be widespread in the community despite recent decontamination attempts. These findings highlight the need to strengthen national and international efforts to address this global public health problem.

NEWS | SCIENCE SELECTION

Mass Lead Poisoning in Dakar: Battery Recycling Exacts a Heavy Toll

HEAVY METALS

Childhood Lead Exposure After the Phaseout of Leaded Gasoline: An Ecological Study of School-Age Children in Kampala, Uganda

Lauren K. Graber, Daniel Asher, Natasha Anandaraja, Richard F. Bopp, Karen Merrill, Mark R. Cullen, Samuel Luboga, Leonardo Trasande (June) 118:884–889.

Although tetraethyl lead was phased out of gasoline in Uganda in 2005, there are still concerns about the exposure of children through other sources. Graber et al. measured blood lead distributions among schoolchildren living near the Kiteezi landfill in Kampala, using a stratified, cross-sectional design to obtain blood samples, questionnaire data, and soil and dust samples from the homes and schools of 4- to 8-year-old children. The mean blood lead level (BLL) was $7.15 \mu\text{g/dL}$, and $> 20\%$ of the children had BLLs $\geq 10 \mu\text{g/dL}$. Participants whose families owned fewer household items, ate canned food, or used the community water supply as their primary water source tended to have higher BLLs, and children living within 0.5 miles of the landfill were 3 times more likely to have elevated BLLs than children living farther away. Dust and soil lead were not significant predictors of BLL. The authors conclude that exposure to high levels of lead remains prevalent among school-aged children in Kampala in spite of the removal of lead from gasoline.

PESTICIDES

Malaria Control Insecticide Residues in Breast Milk: The Need to Consider Infant Health Risks

Hindrik Bouwman, Henrik Kylin (October) 117:1477–1480.

The World Health Organization Pesticide Evaluation Scheme (WHOPES) is used to assess the safety and efficacy of insecticides used for malaria control, including dichlorodiphenyltrichloroethane (DDT) and 12 other insecticides currently recommended for indoor residual spraying and bed nets. Bouwman and Kylin note that WHOPES does not consider potential health effects of non-DDT pesticide exposures via breast milk, despite the potential for breast milk to be an important route of exposure for infants and children. The authors review exposures and health effects of these compounds in breast milk, and argue that this information should be incorporated in WHOPES evaluations. They suggest that additional research is needed to quantify exposures, including exposures through home and garden use, and clarify risks, including those risks associated with exposures to multiple insecticides. The authors conclude that risks are unlikely to outweigh benefits of malaria control, but note that this does not obviate the need to reduce risks whenever possible.

PESTICIDES

Biomonitoring Data for 2,4-Dichlorophenoxyacetic Acid in the United States and Canada: Interpretation in a Public Health Risk Assessment Context Using Biomonitoring Equivalents

Lesla L. Aylward, Marsha K. Morgan, Tye E. Arbuckle, Dana B. Barr, Carol J. Burns, Bruce H. Alexander, Sean M. Hays (February) 118:177–181.

Urinary concentrations of the herbicide 2,4-dichlorophenoxyacetic acid (2,4-D) have been measured in general populations, farm applicators, and farm family members, but until recently it has not been possible to relate these biomonitoring data to reference dose (RfD) guidelines for acceptable levels of acute or chronic 2,4-D exposure. Aylward et al. compare published biomonitoring data with recently derived Biomonitoring Equivalents (BEs; urinary 2,4-D concentrations that correspond to RfDs) to determine whether population exposures appear consistent with current guidelines. The authors report that median urinary 2,4-D concentrations in general U.S. populations were approximately 200 times lower than the guideline value for chronic exposure. Median 2,4-D exposures reported for pesticide applicators and family members were 25 times lower than the guideline value for acute (occupational) exposure, although the highest urinary concentration reported was above the occupational BE. The authors conclude that findings support the value of the BE approach for assessing population risks based on biomonitoring data and suggest that current 2,4-D exposures are generally below reference values for acceptable exposure levels.

PESTICIDES

Developmental Changes in PON1 Enzyme Activity in Young Children and Effects of PON1 Polymorphisms

Karen Huen, Kim Harley, Jordan Brooks, Alan Hubbard, Asa Bradman, Brenda Eskenazi, Nina Holland (October) 117:1632–1638.

Activity of the paraoxonase 1 (PON1) enzyme, which detoxifies activated organophosphorus pesticides (OPs) and reduces oxidative stress, has previously been shown to vary according to genotype and age, with lower levels of PON1 activity in children than in adults. However, information on age-related changes in PON1 activity is limited. Huen et al. measured *PON1* genotypes (polymorphisms at positions 192 and –108) and PON1 activity from birth through 7 years of age in 458 children (108 with data from four or more time points) in the CHAMACOS study, a cohort of predominantly Mexican-American women and children with relatively high occupational and environmental OP exposures. The authors report that relatively low levels of PON1 activity persisted in young children through at least 7 years of age, suggesting a larger window of vulnerability to adverse effects of OPs than expected based on previous research. In addition, they noted that children with low-activity genotypes may be particularly vulnerable to OPs compared with other children because of lower PON1 activity overall and a slower increase in activity with age.

NEWS | SCIENCE SELECTION

Variable Vulnerability: Genotype Determines Timing of PON1 Capability to Detoxify Pesticides

RELATED ARTICLES

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Out of Plumb: When Water Treatment Causes Lead Contamination

Rebecca Renner (December) 117:A543–A547.



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Rebecca Renner (February) 118:A69–A74.

NEWS | SPHERES OF INFLUENCE

Lead in Air: Adjusting to a New Standard

Charles W. Schmidt (February) 118:A77–A79.

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Reaction to the Solution: Lead Exposure Following Partial Service Line Replacement

Rebecca Renner (May) 118:A202–A208.

PESTICIDES

The Implications of Using a Physiologically Based Pharmacokinetic (PBPK) Model for Pesticide Risk Assessment

Chensheng Lu, Christina M. Holbrook, Leo M. Andres (January) 118:125–130.

Physiologically based pharmacokinetic (PBPK) models use information on chemical absorption, distribution, metabolism, and elimination to estimate relations between external exposures and internal doses. In addition, PBPK models may be used to estimate risks according to different exposure scenarios and individual characteristics. Lu et al. developed a PBPK model to predict urinary excretion of the chlorpyrifos (CPF) metabolite 3,5,6-trichloro-2-pyridinol (TCPY) in children and compared predicted urinary TCPY excretion with observed values measured in four spot urine samples collected from 13 children 36 years of age. Model parameters were based on PBPK models for rats and adult humans; CPF levels in environmental samples (drinking water, outdoor soil, house dust, toy wipe, and indoor air from each child's home) and duplicate 24-hr food samples were used to estimate exposures. Predictions were substantially lower than measured values in 11 children but were within 75% of measured values in 2 children with detectable levels of CPF (12 and 350 ng/g) in their dietary samples. The authors conclude that exposure measurement errors probably contributed to poor model performance and that evidence of more accurate estimates for children with measurable dietary CPF levels suggests that the model will perform well when dietary intake is the primary route of CPF exposure.

PESTICIDES

Urinary Concentrations of Metabolites of Pyrethroid Insecticides in the General U.S. Population: National Health and Nutrition Examination Survey 1999–2002

Dana Boyd Barr, Anders O. Olsson, Lee-Yang Wong, Simeon Udunka, Samuel E. Baker, Ralph D. Whitehead Jr., Melina S. Magsumbol, Bryan L. Williams, Larry L. Needham (June) 118:742–748.

Synthetic pyrethroid insecticides are being used with greater frequency in the United States to replace residential and some agricultural organophosphorus (OP) and carbamate insecticides. The pyrethroids are considered to be less toxic to humans than the OPs and carbamates, but like many other classes of insecticides, they are acute neurotoxicants. Barr et al. assessed human exposure to pyrethroid insecticides in a representative sample of the general U.S. population ≥ 6 years of age. 3-Phenoxybenzoic acid (3PBA), a metabolite common to many pyrethroid insecticides, was detected in $> 70\%$ of urine samples tested. Non-Hispanic blacks had significantly higher 3PBA concentrations than non-Hispanic whites and Mexican Americans, and children had significantly higher concentrations of 3PBA than adolescents and adults. *Cis*- and *trans*-(2,2-dichlorovinyl)-2,2-dimethylcyclopropane-1-carboxylic acid were highly correlated with each other and with 3PBA, suggesting that urinary 3PBA was primarily derived from exposure to permethrin, cypermethrin, or their degradates. The authors conclude that pyrethroid insecticide exposure in the U.S. population is widespread and that children may have higher exposures than adolescents and adults.

OTHER CHEMICALS (BPA, PCBs, PBDEs, PFCs, PHTHALATES)

Does Rapid Metabolism Ensure Negligible Risk from Bisphenol A?

Gary Ginsberg, Deborah C. Rice (November) 117:1639–1643.

Human experimental studies of bisphenol A (BPA) metabolism have reported rapid clearance of the hormonally active parent compound via glucuronide conjugation followed by urinary excretion of the inactive conjugated metabolite. BPA also undergoes glucuronide conjugation in rats, but the conjugated metabolite is excreted in bile or feces (vs. urine) and may be converted back to unconjugated BPA by hepatic β -glucuronidase enzymes, thus increasing the duration of internal exposure to hormonally active BPA. According to Ginsberg and Rice, this interspecies difference is used to support arguments against the human health relevance of low-dose BPA effects in rats. The authors dispute this assumption and argue that human risk assessment models that assume rapid metabolic clearance ignore the potential for increased *in utero* exposure to active BPA due to metabolic deconjugation in the placenta and other tissues. The authors cite evidence to support this mechanism and conclude that potential risks of low-dose exposures should not be dismissed until effects of local deconjugation reactions are incorporated into risk assessment models.

OTHER CHEMICALS (BPA, PCBs, PBDEs, PFCs, PHTHALATES)

Polyethylene Terephthalate May Yield Endocrine Disruptors

Leonard Sax (April) 118:445–448.

Polyethylene terephthalate (PET) is widely used to make clear plastic bottles for bottled water and containers for other beverages, condiments, and cosmetic products. There is concern that estrogenic chemicals such as phthalates may leach into the contents from bottles made from PET, although PET is not a phthalate derivative. Sax describes several studies suggesting that water from PET bottles can have estrogenic activity in some bioassays and that phthalates might leach from PET bottles. The author notes the difficulties in evaluating these studies, especially in cases where there may have been prior contamination of the water or the containers with estrogenic agents or phthalates. Sax suggests that the phthalate content of PET bottles, if present, might vary as a function of the acidity of the product and the temperature and duration of storage. Sax also makes the observation that other nonphthalate chemicals such as antimony, which is used as a catalyst in the polycondensation of PET, might also contribute to the endocrine-disrupting activity of products stored in PET containers. The widespread use of PET plastic for a variety of applications suggests that additional research is needed.

OTHER CHEMICALS (BPA, PCBs, PBDEs, PFCs, PHTHALATES)

Biomonitoring Studies Should Be Used by Regulatory Agencies to Assess Human Exposure Levels and Safety of Bisphenol A

Laura N. Vandenberg, Ibrahim Chahoud, Vasantha Padmanabhan, Francisco J.R. Paumgarten, Gilbert Schoenfelder (August) 118:1051–1054.

In 2006, the European Food Safety Authority (EFSA) concluded that "... there is very low oral bioavailability of the parent substance, BPA [bisphenol A], in humans and other primates" and that because of the "rapid biotransformation and excretion and plasma protein binding in humans, peak BPA concentrations after dietary exposures to BPA available for receptor binding are predicted to be very low even in worst case exposure scenarios." In their Commentary, Vandenberg et al. point out that the EFSA relied on two toxicokinetic studies and a limited number of urine biomonitoring studies to draw conclusions about exposure levels in the population, including exposures of neonates. The authors note that the EFSA panel dismissed many biomonitoring studies that documented significant levels of BPA exposure in humans, including internal exposures to unconjugated BPA, because the studies did not match a preconceived model of BPA metabolism. On the basis of > 80 biomonitoring studies, the authors conclude that—as with all exposure assessments—models should be developed to explain actual data collected, and that samples from a large number of human subjects clearly indicate that humans are internally exposed to unconjugated BPA. The authors propose that all available data be considered in order to make informed decisions about the risk of exposure to BPA in humans.

OTHER CHEMICALS (BPA, PCBs, PBDEs, PFCs, PHTHALATES)

Urinary, Circulating, and Tissue Biomonitoring Studies Indicate Widespread Exposure to Bisphenol A

Laura N. Vandenberg, Ibrahim Chahoud, Jerrold J. Heindel, Vasantha Padmanabhan, Francisco J.R. Paumgarten, Gilbert Schoenfelder (August) 118:1055–1070.

Bisphenol A (BPA) is one of the highest-volume chemicals produced worldwide, and there is concern that humans may be exposed to concentrations of BPA capable of causing adverse health effects. Toxicokinetic studies in humans suggest that BPA is quickly metabolized in the liver and intestines, thus posing little risk. However, in biomonitoring studies, BPA has been measured in tissues and fluids in individuals exposed to BPA in the environment, suggesting that humans may be at risk due to nonoccupational exposure. Vandenberg et al. reviewed > 80 published human biomonitoring studies that measured BPA concentrations in human tissues, urine, blood, and other fluids, and found that these studies overwhelmingly detected BPA in adults, adolescents, and children. Unconjugated BPA was routinely detected in blood, and conjugated BPA was detected in the vast majority of urine samples. The authors conclude that results from biomonitoring studies indicate that the general population is exposed to BPA and is at risk from internal exposure to unconjugated BPA. They suggest that basing risk assessment on a limited number of toxicokinetic studies is problematic.

NEWS | SCIENCE SELECTION

Body of Proof: Biomonitoring Data Reveal Widespread Bisphenol A Exposures

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Mystery in a Bottle: Will the EPA Require Public Disclosure of Inert Pesticide Ingredients?

Bob Weinhold (April) 118:A168–A171.



PODCAST | A RESEARCHER'S PERSPECTIVE

Human Exposure to PBDEs

with Heather Stapleton (1 May 2010)

Flame retardants known as polybrominated diphenyl ethers (PBDEs) are added to products such as furniture, car seats, textiles, and electronics. Now they are also showing up in the food we eat, the dust in our houses, and the bodies of possibly the entire U.S. population.

PODCAST | A RESEARCHER'S PERSPECTIVE

Breastfeeding: An Ancient Paradigm in Today's World

with Lynn R. Goldman (15 October 2009)

A number of recent studies have reported finding measurable levels of persistent organic pollutants in human milk, and many daily activities expose nursing women to toxic chemicals that can end up in their milk.

PODCAST | A RESEARCHER'S PERSPECTIVE

Long-Term Effects of Bisphenol A Exposure

with Retha Newbold (16 June 2009)

Cities and states across the United States, as well as other nations abroad, are banning bisphenol A (BPA) due to concerns about adverse health effects of low doses of this widely used industrial compound, particularly among fetuses, infants, and young children.

PODCAST | A RESEARCHER'S PERSPECTIVE

Fossil Fuel Emissions and Children's Health

with Frederica Perera (29 May 2009)

Children are generally more vulnerable to environmental insults because their bodies are still developing, but just as early exposures can cause lifelong adverse effects, so can early interventions produce lifelong benefits.

OTHER CHEMICALS (BPA, PCBs, PBDEs, PFCs, PHTHALATES)

Predictors of Serum Dioxins and PCBs among Peripubertal Russian Boys

Jane S. Burns, Paige L. Williams, Oleg Sergeev, Susan Korrick, Mary M. Lee, Boris Revich, Larisa Altshul, Donald G. Patterson Jr., Wayman E. Turner, Larry L. Needham, Igor Saharov, Russ Hauser (October) 117:1593–1599.

Extensive chemical manufacturing in Chapaevsk, Russia, has resulted in high environmental contamination with dioxins, furans, and polychlorinated biphenyl compounds (PCBs). Burns et al. analyzed baseline data from 482 Chapaevsk boys 8–9 years of age (participants in the Russian Children's Study cohort) to identify predictors of serum dioxin and PCB levels at enrollment in 2003–2005. Boys who were older, consumed local foods, and were breast-fed longer, and boys whose mothers were employed at the Khimprom chemical manufacturing plant or had a local garden plot, had significantly higher serum dioxins and PCBs than other boys. Distance of the boys' homes from the Khimprom plant was strongly associated with total toxic equivalents (TEQs) for all measured compounds combined, with an estimated adjusted mean TEQ of 30.6 pg/g lipid [95% confidence interval (CI), 26.8–35.0] for boys that lived < 2 km from the plant compared with 18.8 pg/g lipid (95% CI, 17.2–20.6) for boys living > 5 km away. The authors recommend soil remediation and garden plot relocations to reduce exposures in this community.

OTHER CHEMICALS (BPA, PCBs, PBDEs, PFCs, PHTHALATES)

Do Human Milk Concentrations of Persistent Organic Chemicals Really Decline During Lactation? Chemical Concentrations During Lactation and Milk/Serum Partitioning

Judy S. LaKind, Cheston M. Berlin Jr., Andreas Sjödin, Wayman Turner, Richard Y. Wang, Larry L. Needham, Ian M. Paul, Jennifer L. Stokes, Daniel Q. Naiman, Donald G. Patterson Jr. (October) 117:1625–1631.

It has generally been assumed that concentrations of persistent organic chemicals in breast milk decline over the course of lactation and that initial levels reflect the mother's cumulative lifetime exposure. LaKind et al. studied changes in persistent organic chemicals in breast milk samples collected 1, 2, and 3 months postpartum and at the end of lactation from a convenience sample of 10 women from Pennsylvania. The same chemicals also were measured in serum samples collected at the first and last milk donation to assess milk:serum partition coefficients. Lipid-adjusted concentrations of polybrominated diphenyl ethers, polychlorinated biphenyls, polychlorinated dibenzo-*p*-dioxins and furans, and organochlorine pesticides in serum and milk did not consistently decrease during lactation; milk:serum partitioning was unpredictable and may have been dependent on chemical characteristics. The authors conclude that decreasing concentrations of lipophilic chemicals during lactation should no longer be assumed.

OTHER CHEMICALS (BPA, PCBs, PBDEs, PFCs, PHTHALATES)

Individual Characteristics Associated with PBDE Levels in U.S. Human Milk Samples

Julie L. Daniels, I-Jen Pan, Richard Jones, Sarah Anderson, Donald G. Patterson Jr., Larry L. Needham, Andreas Sjödin (January) 118:155–160.

Children are exposed to polybrominated diphenyl ethers (PBDEs) *in utero* and through breast milk, but factors that might predict exposure levels have not been evaluated. Daniels et al. measured PBDEs in breast milk samples obtained during 2004–2006 from 303 North Carolina participants in the Pregnancy, Infections, and Nutrition Study. PBDEs were measured in samples obtained 3 months postpartum and were also measured 12 months postpartum in 83 women. PBDE congeners BDE-28, -47, -99, -100, and -153 were detected in > 70% of samples, with the highest concentrations measured for BDE-47 (median, 28 ng/g lipid). The authors report that PBDE concentrations were lower in samples from mothers > 34 years of age compared with younger mothers, and higher in samples from obese mothers compared with normal weight mothers, but PBDE concentrations were not associated with parity. Changes PBDEs between 3- and 12-month samples were highly variable, but concentrations tended to increase. The authors suggest that high PBDE concentrations in study-participant samples relative to other study populations may reflect differences in exposure or other characteristics among study populations.

OTHER CHEMICALS (BPA, PCBs, PBDEs, PFCs, PHTHALATES)

Exposure to Polyfluoroalkyl Chemicals and Cholesterol, Body Weight, and Insulin Resistance in the General U.S. Population

Jessica W. Nelson, Elizabeth E. Hatch, Thomas F. Webster (February) 118:197–202.

Polyfluoroalkyl chemicals (PFCs)—including perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorooctane sulfonic acid (PFOS), and perfluorohexane sulfonic acid (PFHxS)—are synthetic compounds that bind to proteins in the liver and serum, and are consistently detected in human serum samples. Epidemiologic studies have reported positive associations between serum PFCs and serum cholesterol levels in humans, but many have included highly exposed populations, and few have evaluated potential effects of PFNA and PFHxS. Nelson et al. analyzed serum concentrations of PFOA, PFOS, PFNA, and PFHxS in association with serum cholesterol levels, body mass index, waist circumference, and a proxy measure of insulin resistance among participants in the 2003–2004 National Health and Nutrition Examination Survey (NHANES). The authors report that serum levels of total cholesterol and non-high-density cholesterol (non-HDL or “bad” cholesterol) were increased in association with PFOS, PFOA, and PFNA among 860 adults (20–80 years of age) who were not using cholesterol-lowering medications. In contrast, total cholesterol was inversely associated with serum PFHxS concentrations, and body size and insulin resistance were not consistently associated with PFCs in the study population. The authors conclude that their results suggest effects of environmentally relevant PFC exposures on cholesterol metabolism, but they note that additional studies are needed to confirm associations and clarify biologic mechanisms.

NEWS | SCIENCE SELECTION

PFCs and Cholesterol: A Sticky Connection

OTHER CHEMICALS (BPA, PCBs, PBDEs, PFCs, PHTHALATES)

Exposure of the U.S. Population to Acrylamide in the National Health and Nutrition Examination Survey 2003–2004

Hubert W. Vesper, Samuel P. Caudill, John D. Osterloh, Tunde Meyers, Deanna Scott, Gary L. Myers (February) 118:278–283.

Human exposure to acrylamide, a neurotoxicant and suspected human carcinogen, occurs via dietary sources, tobacco smoke, and occupational production or use. Carcinogenic effects are attributed to DNA adducts formed with the phase I metabolite glycidamide, and body burdens and risks may be partly determined by factors that influence acrylamide metabolism, including genetic variants and factors that induce metabolism gene expression (e.g., medications and alcohol). Vesper et al. measured hemoglobin adducts of acrylamide (HbAA) and glycidamide (HbGA) in blood samples from 7,166 participants in the National Health and Nutrition Examination Survey, and estimated HbGA:HbAA ratios to assess variation in metabolic conversion. The authors report that smokers had the highest adjusted geometric mean levels of HbAA and HbGA and that adduct levels in nonsmokers were associated with tobacco smoke exposure (based on serum cotinine levels). In addition, adduct levels and HbGA:HbAA ratios were higher in children 3–11 years of age than in adults ≥ 60 years of age, and in Mexican Americans compared with other participants. The authors note that differences among population subgroups were modest relative to differences among individuals within subgroups, and suggest that factors other than sex, age, and race/ethnicity may be primarily responsible for variation in acrylamide exposure and metabolism.

OTHER CHEMICALS (BPA, PCBs, PBDEs, PFCs, PHTHALATES)

Urinary Concentrations of Four Parabens in the U.S. Population: NHANES 2005–2006

Antonia M. Calafat, Xiaoyun Ye, Lee-Yang Wong, Amber M. Bishop, Larry L. Needham (May) 118:679–685.

Parabens are esters of *p*-hydroxybenzoic acid used as antimicrobial preservatives, especially against molds and yeast, in cosmetics, pharmaceuticals, and in food and beverage processing. Despite their widespread use, little is known about actual exposure to parabens in the United States. Calafat et al. assessed exposure to methyl, ethyl, propyl, and butyl parabens in a representative sample of 2,548 participants ≥ 6 years of age in the 2005–2006 National Health and Nutrition Examination Survey (NHANES). The authors detected methyl paraben (MP) and propyl paraben (PP) in 99.1% and 92.7% of urine samples, respectively. Ethyl and butyl parabens were less frequently detected. Concentrations of MP were significantly higher among non-Hispanic blacks than non-Hispanic whites, except at older ages. Adolescent and adult females had significantly higher concentrations of MP and PP than adolescent and adult males. Females were more likely than males, and non-Hispanic blacks were more likely than non-Hispanic whites, to have higher concentrations. The authors conclude that the general U.S. population was exposed to several parabens during 2005–2006. Differences in the urinary concentrations of MP and PP by sex and race/ethnicity probably reflect the use of personal care products containing these compounds.

RELATED ARTICLES

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A Matter of Degrees: Advancing Our Understanding of Acrylamide

Angela Spivey (April) 118:A160–A167.



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More Iodine or Less Perchlorate?

Rebecca Renner (July) 118:A289.

EDITORIAL

TSCA Reform Under Way in Congress

Linda S. Birnbaum (March) 118:A106.

BUILT ENVIRONMENT

Predicting Residential Exposure to Phthalate Plasticizer Emitted from Vinyl Flooring: Sensitivity, Uncertainty, and Implications for Biomonitoring

Ying Xu, Elaine A. Cohen Hubal, John C. Little (February) 118:253–258.

Biomonitoring data suggest that humans are widely exposed to phthalate plasticizers such as di(2-ethylhexyl) phthalate (DEHP), but major sources and pathways of exposure have not been determined, despite concerns about the potential for adverse health effects in vulnerable or highly exposed populations. Xu et al. developed a three-compartment model to estimate exposure to DEHP emitted from vinyl flooring in a family residence (including exposure via inhalation, dermal absorption, and oral ingestion) and used this model to identify model parameters with the greatest influence on exposure. Predicted exposure levels varied by a factor of 40 depending on model assumptions, with predicted exposures above reference dose guidelines for DEHP under some scenarios; influential model parameters included surface area and initial concentration of DEHP in vinyl flooring, DEHP emission rates, and room air ventilation rates. The authors conclude that the mechanistic modeling approach they have developed for DEHP can be extended to predict phthalate exposures from other sources, as well as exposures to flame retardants and other semivolatile organic compounds found in homes and consumer products.

NEWS | SCIENCE SELECTION

**Running Phthalates to Ground:
Pinpointing Exposure Sources in a Virtual Home**

BUILT ENVIRONMENT

Urban Area Disadvantage and Under-5 Mortality in Nigeria: The Effect of Rapid Urbanization

Diddy Antai, Tahereh Moradi (June) 118:877–883.

Living in socioeconomically disadvantaged areas is associated with increased childhood mortality. As city living becomes the predominant social context in low- and middle-income countries, the resulting rapid urbanization—along with the poor economic circumstances of these countries—greatly increases the risk of mortality for children < 5 years of age (under-5 mortality). Antai and Moradi examined trends in urban population growth and urban under-5 mortality between 1983 and 2003 in Nigeria and associations with socioeconomic disadvantage in these areas. Urban under-5 mortality increased as urban population steadily increased between 1983 and 2003. Urban area disadvantage was significantly associated with under-5 mortality after adjusting for individual child- and mother-level demographic and socioeconomic characteristics. The authors conclude that their findings underscore the need for community- and individual-level interventions. Additional studies are needed on community-level determinants of under-5 mortality in disadvantaged urban areas.

NEWS | SCIENCE SELECTION

A Marked Disadvantage: Rapid Urbanization and Mortality of Young Children in Nigeria

CLIMATE CHANGE

Environmental Health Indicators of Climate Change for the United States: Findings from the State Environmental Health Indicator Collaborative

Paul B. English, Amber H. Sinclair, Zev Ross, Henry Anderson, Vicki Boothe, Christine Davis, Kristie Ebi, Betsy Kagey, Kristen Malecki, Rebecca Shultz, Erin Simms (November) 117:1673–1681.

It is generally believed that increases in temperature and other weather changes will occur over time, even under optimistic scenarios for greenhouse gas reduction. English et al. discuss the need for accurate surveillance data and indicators of vulnerability and preparedness to predict human health impacts and develop successful mitigation and adaptation strategies. The authors identify potential surveillance indicators (e.g., climate-sensitive health outcomes; environmental and vulnerability indicators; and mitigation, adaptation, and policy indicators) and review available data sources. They conclude that data are available for many of the proposed measures but sensitivity and utility need to be evaluated. They also note that additional efforts are needed to increase data quality and availability and to develop new surveillance databases, especially for climate-sensitive morbidity.

NEWS | SCIENCE SELECTION

**Sentinel Symptoms of Climate Change:
Indicators for Related Health Effects**

FOOD SAFETY AND NUTRITION

Diet Contributes Significantly to the Body Burden of PBDEs in the General U.S. Population

Alicia J. Fraser, Thomas F. Webster, Michael D. McClean (October) 117:1520–1525.

Polybrominated diphenyl ethers (PBDEs) are persistent environmental contaminants with evidence of endocrine, developmental, and other effects. North Americans are thought to be exposed primarily through contaminated dust and food sources, but information linking serum PBDE levels to diet is limited. Fraser et al. analyzed data from a random sample of participants in the 2003–2004 National Health and Nutrition Examination Survey who had serum measures of PBDE congeners (including PBDEs 28, 47, 99, 100, and 153) [based on a 24-hr food recall (24FR) and a 1-year food frequency questionnaire (FFQ)], and information on potential confounders ($n = 1,892$ with complete data). The authors report that PBDE serum concentrations were 23–27% lower among vegetarians than omnivores. Poultry fat and red meat fat intakes were positively associated with serum PBDEs, but dairy or fish consumption was not. Results were similar for estimates based on 24FR and FFQ dietary instruments. The authors suggest that additional research is needed to determine mechanisms through which PBDEs enter the food chain.

NEWS | SCIENCE SELECTION

PBDEs in Diet: Meat Fat a Leading Source

FOOD SAFETY AND NUTRITION

The Melamine Incident: Implications for International Food and Feed Safety

Céline Marie-Elise Gossner, Jørgen Schlundt, Peter Ben Embarek, Susan Hird, Danilo Lo-Fo-Wong, Jose Javier Ocampo Beltran, Keng Ngee Teoh, Angelika Tritscher (December) 117:1803–1808.

Melamine is an inexpensive high-production-volume chemical that has been deliberately added to raw milk, animal feeds, and other food products to falsely increase their apparent protein content. Melamine is rapidly absorbed and primarily excreted unchanged in the urine, where it may form calculi (stones) in the urinary tract when present at high concentrations. Gossner et al. describe a major food safety incident that caused 6 reported deaths and affected approximately 300,000 Chinese infants and young children exposed to melamine-contaminated infant formulas. Subsequently, melamine was detected in food and feed products in 47 countries. The authors discuss factors that contributed to the severity of this incident, including delays in reporting and the complexity of international trade of food products and ingredients; they emphasize the need for rapid international collaboration, data sharing, and use of common testing and reporting methods to manage future food-safety incidents and protect public health.

NEWS | SCIENCE SELECTION

Chronicle of a Health Crisis: Global Implications of the 2008 Melamine Event

METHODOLOGIES

Vulnerability-Based Spatial Sampling Stratification for the National Children's Study, Worcester County, Massachusetts: Capturing Health-Relevant Environmental and Sociodemographic Variability

Timothy J. Downs, Yelena Ogneva-Himmelberger, Onesky Aupont, Yangyang Wang, Ann Raj, Paula Zimmerman, Robert Goble, Octavia Taylor, Linda Churchill, Celeste Lemay, Thomas McLaughlin, and Marianne Felice (September) 118:1318–1325.

The overall objective of the National Children's Study (NCS) is to assess how environmental factors may affect child health and development by following 100,000 children from gestation until 21 years of age. One major concern for the NCS is the development of a protocol for selecting the sample of > 1,000 children in each of 105 study sites. All NCS study sites are faced with the challenge of how to stratify their sites in ways that represent local social and natural environmental variability but, to date, no standardized protocol exists for stratification of the target population and the diverse environments they inhabit. Downs et al. describe an approach for one study site, Worcester County, Massachusetts, for which they developed a multivariable, vulnerability-based method for spatial sampling consisting of two descriptive indices: a hazards/stressors exposure index and an adaptive capacity/sociodemographic character index. The authors conclude that their approach offers moderate to high potential to inform other sites, limited by intersite differences in data availability, geodemographics, and technical capacity.

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Tanya Tillett (August) 118:A335.

EDITORIAL

Are We Really Addressing the Core of Children's Environmental Health?

Nsedu Obot Witherspoon (October 2009) 117:A428–A429.

METHODOLOGIES

Using National and Local Extant Data to Characterize Environmental Exposures in the National Children's Study: Queens County, New York

Paul J. Lioy, Sastry S. Isukapalli, Leonardo Trasande, Lorna Thorpe, Michael Dellarco, Clifford Weisel, Panos G. Georgopoulos, Christopher Yung, Shahnaz Alimokhtari, Margot Brown, Philip J. Landrigan (October) 117:1494–1504.

The National Children's Study (NCS), a longitudinal epidemiologic study to identify exposures and preventable causes of childhood disease, will enroll 100,000 children from 105 locations across the United States. Dust, water, and other samples will be collected to assess residential exposures, but additional data will be needed to fully characterize exposures over time. Lioy et al. review information sources that will be used to determine exposures in Queens, New York (one of seven NCS pilot study locations), including existing national, regional, and local databases with information on air and water quality, waste sites, toxics emissions and spills, dietary intakes, pesticide use, geographic features, land cover and land use, meteorologic data, and other characteristics. These data will be used to develop and test a method for defining environmental exposure indices that may be applied across NCS sites. However, the authors note that data collection efforts at each NCS site will need to be customized to account for local characteristics and data sources, and that walk- or drive-through surveys will be necessary to fully characterize local variation within study sites.

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