

OCTOBER 2010–SEPTEMBER 2011

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NIH PUBLICATION 2011-218
ISSN 0091-6765

Disease Outcomes

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- Air Pollution (Particulate Matter/Smoke/Indoor Air)
- Endotoxins and Water Toxins
- Built Environment
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- Natural Disasters
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PREFACE

Children's Health Collection 2011 comprises all relevant articles published in *EHP* from the October 2010 issue (devoted mostly to Children's Health) through September 2011: peer-reviewed research articles (including reviews and commentaries), news articles, Science Selections, editorials, and podcasts. 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 (ehponline.org). In addition, each article can be searched by author, key word, or phrase, and additional research previously published can also be easily accessed.

Some of the new topics this year reflect increasingly important areas of research. For example, the section on "Infections" includes illnesses that stem at least partly from global changes in climate as well as growing poverty; "Climate Change," in parallel, has more articles this year. "Natural Disasters," a small topic this year, is likely to see more research in the future. The largest new category, "Air Pollution: Particulate Matter/Smoke/Indoor Air," contains microlevel (e.g., use of individual monitors) and macrolevel (e.g., large cohort studies, global public health implications) research, including the important emerging topic of thirdhand tobacco smoke exposure.

We have seen an increase in articles on exposure to pesticides and other chemicals as well as climate change. Medical topics include vaccines and antibodies; asthma and allergy; infections; a variety of neurodevelopmental disorders, including a case report on prenatal exposure to bisphenol A and neurobehavior; and a variety of adult diseases with their basis in childhood exposure.

Individual, community, regional, national, and global exposures and outcomes are being studied not only because, of course, we want our own children to thrive, but also because healthy children tend to grow into a healthy and productive adult population. The end results of prevention and early remediation of environmental hazards include long-term economic and social benefits as well as health. Given that the effects of climate change and air and water pollution, for example, are not bound by regions or nations, it is important to improve nurturing environments for all children, regardless of nationality or economic status.



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ASTHMA/RESPIRATORY DISEASE, LUNG DEVELOPMENT, ALLERGY

Respiratory Health Effects of Exposure to Low-NO_x Unflued Gas Heaters in the Classroom: A Double-Blind, Cluster-Randomized, Crossover Study

Guy B. Marks, Wafaa Ezz, Nathan Aust, Brett G Toelle, Wei Xuan, Elena Belousova, Carmen Cosgrove, Bin Jalaludin, Wayne T. Smith (October 2010) 118:1476–1482.

Although there are long-standing concerns about adverse effects of gas appliances on respiratory health, the potential adverse effect of low-nitrogen oxide (NO_x) unflued gas heaters on children's health has not been studied. In a double-blind, cluster-randomized crossover study conducted in 400 primary school students attending schools in New South Wales, Australia, Marks et al. compared respiratory health effects and air quality consequences of exposure to low-NO_x gas heaters with exposure to non-indoor-air-emitting flued gas heaters in school classrooms. The authors found that concentrations of nitrogen dioxide and formaldehyde were significantly higher during exposure to unflued versus flued gas heaters. Although there was no evidence of adverse effects on lung function, respiratory symptoms were increased during exposure to the unflued versus flued gas heaters. Specifically, exposure to the unflued gas heaters was associated with increased cough reported in the evening and wheeze reported in the morning; the association with wheeze was greater in atopic subjects.

ASTHMA/RESPIRATORY DISEASE, LUNG DEVELOPMENT, ALLERGY

Short-Term Effects of Air Pollution on Wheeze in Asthmatic Children in Fresno, California

Jennifer K. Mann, John R. Balmes, Tim A. Bruckner, Kathleen M. Mortimer, Helene G. Margolis, Boriana Pratt, S. Katharine Hammond, Frederick W. Lurmann, Ira B. Tager (October 2010) 118:1497–1502.

Although studies have demonstrated that air pollution is associated with exacerbation of symptoms in children with asthma, little is known about the susceptibility of various subgroups. Mann et al. examined the possibility that identifiable subgroups of asthmatic children are more likely to wheeze after exposure to ambient air pollution. A cohort of 315 children with asthma (6–11 years of age) was recruited for longitudinal follow-up study. During the baseline visit, children were administered a respiratory symptom questionnaire and an allergen skin-prick test. Three times a year, participants completed 14-day panels during which they answered symptom questions twice daily. The authors used ambient air quality data from a central monitoring station to assign exposures to various air pollutants. Wheeze was significantly associated with short-term exposures to nitrogen oxide and particulate matter (PM). The association was stronger in children who were skin-test positive to cat or common fungi antigens and in boys with mild intermittent asthma. The authors suggest a need to identify the components of coarse PM that contribute to asthma morbidity and recommend that particular attention should be paid to concomitant environmental exposures that could exacerbate the effects of air pollution.

ASTHMA/RESPIRATORY DISEASE, LUNG DEVELOPMENT, ALLERGY

Allergy and Sensitization during Childhood Associated with Prenatal and Lactational Exposure to Marine Pollutants

Philippe Grandjean, Lars K. Poulsen, Carsten Heilmann, Ulrike Steuerwald, Pál Weihe (October 2010) 118:1429–1433.

Grandjean et al. studied whether sensitization and development of allergic disease is associated with duration of breast-feeding and perinatal exposures to polychlorinated biphenyls (PCBs) and methylmercury. The duration of breast-feeding and history of asthma and atopic dermatitis were recorded in children at clinical examinations at 5 and 7 years of age. PCB and mercury concentrations were determined in blood samples obtained at parturition and at follow-up. Serum from 7-year-old children was analyzed for total IgE and grass-specific IgE. The authors report that the total IgE concentration in serum was positively associated both with the concomitant serum PCB concentrations and the duration of breast-feeding. An increased grass-specific IgE concentration compatible with sensitization was positively associated with the duration of breast-feeding and inversely associated with prenatal methylmercury exposure. A history of asthma or atopic dermatitis was not associated with the duration of breast-feeding. Children with atopic dermatitis had lower prenatal PCB exposures than did nonallergic children. The authors conclude that developmental exposure to immunotoxicants may affect the risk of allergic disease. Associations between breast-feeding and subsequent allergic disease in children may, at least in part, reflect lactational exposure to immunotoxic food contaminants.

ASTHMA/RESPIRATORY DISEASE, LUNG DEVELOPMENT, ALLERGY

Home Characteristics as Predictors of Bacterial and Fungal Microbial Biomarkers in House Dust

Joanne E. Sordillo, Udeni K. Alwis, Elaine Hoffman, Diane R. Gold, Donald K. Milton (February) 119:189–195.

Sordillo et al. examined whether home characteristics could be used as a proxy for biomarkers of exposure to fungi and bacteria. The authors explored the relationship between home characteristics determined by questionnaire and measures of gram-negative bacteria (GNB), gram-positive bacteria (GPB), and fungal biomarkers in bedroom and family room dust. Dampness was a significant predictor of all microbial exposures, whereas water damage or visible mold/mildew was associated with a 20–66% increase in GNB levels. Cleaning the bedroom at least once a week was associated with reduced GNB, GPB, and fungi. Presence of dogs or cats was associated with increased home bacteria or fungi. The authors conclude that despite their associations with multiple microbial flora, home characteristics only partially explain the variability in microbial biomarker levels and cannot substitute for specific microbial measurements in studies designed to distinguish the effects of specific classes of microbes.

ASTHMA/RESPIRATORY DISEASE, LUNG DEVELOPMENT, ALLERGY

Personal Exposures to Traffic-Related Air Pollution and Acute Respiratory Health among Bronx Schoolchildren with Asthma

Ariel Spira-Cohen, Lung Chi Chen, Michaela Kendall, Ramona Lall, George D. Thurston (April) 119:559–565.

Previous studies have reported relationships between adverse respiratory health outcomes and residential proximity to traffic pollution. These relationships, however, have not been reported at a personal level of exposure. Spira-Cohen et al. compared the associations of adverse asthma outcome incidences with increased personal exposure to fine particle ($\leq 2.5 \mu\text{m}$; $\text{PM}_{2.5}$) mass air pollution versus diesel-related carbonaceous fraction of $\text{PM}_{2.5}$ among inner-city children with asthma. Daily 24-hr personal samples of $\text{PM}_{2.5}$, including the elemental carbon (EC) fraction, were collected for approximately 1 month. Spirometry and symptom scores were recorded several times daily during weekdays. Adverse health associations were strongest with personal measures of EC exposure, suggesting that the diesel “soot” fraction of $\text{PM}_{2.5}$ is most responsible for pollution-related asthma exacerbations among children living proximal to roadways. The authors suggest that studies that rely on exposure to particulate mass may underestimate health impacts of exposure to PM.

ASTHMA/RESPIRATORY DISEASE, LUNG DEVELOPMENT, ALLERGY

Exposure Assessment in Cohort Studies of Childhood Asthma

Victoria H. Arrandale, Michael Brauer, Jeffrey R. Brook, Bert Brunekreef, Diane R. Gold, Stephanie J. London, J. David Miller, Halük Özkaynak, Nola M. Ries, Malcolm R. Sears, Frances S. Silverman, Tim K. Takaro (May) 119:591–597.

The power of cohort studies depends in part on the accuracy of the exposure assessment. Arrandale et al. reviewed the existing literature and suggest strategies for improving exposure assessment in longitudinal cohort studies of childhood asthma and allergies. Exposure assessments require the evaluation of a number of studies with different exposure scenarios. Hypotheses for these studies should be based on proposed mechanisms; critical time windows for effects; prior knowledge of physical, physiologic, and immunologic development; and genetic pathways potentially influenced by the exposures. Evaluating gene–environment interactions will require large cohorts, and planning for data pooling across independent studies is critical. Models that combine air quality, environmental, and dose data can provide exposure estimates across large cohorts. Improving exposure assessment is critical to reduce measurement error, improve power, and increase confidence in characterization of children at risk, leading to improved health outcomes.



ASTHMA/RESPIRATORY DISEASE, LUNG DEVELOPMENT, ALLERGY

Respiratory and Allergic Health Effects of Dampness, Mold, and Dampness-Related Agents: A Review of the Epidemiologic Evidence

Mark J. Mendell, Anna G. Mirer, Kerry Cheung, My Tong, Jeroen Douwes (June) 119:748–756.

Many studies have shown consistent associations between indoor dampness or mold and respiratory or allergic health effects, but causal links remain unclear. Mendell et al. evaluated literature reports for evidence of causation or association between qualitative or subjective assessments of dampness or mold and specific health outcomes. They also considered evidence for associations between specific quantitative measurements of microbiologic factors and each health outcome. Evident dampness or mold had consistent positive associations with multiple allergic and respiratory effects. Measured microbiologic agents in dust had limited suggestive associations, including both positive and negative associations for some agents. Although prevention and remediation of indoor dampness and mold are likely to reduce health risks, current evidence does not support measuring specific indoor microbiologic factors to guide health-protective actions.

NEURODEVELOPMENTAL/NEUROBEHAVIORAL DISORDERS

Intellectual Function in Mexican Children Living in a Mining Area and Environmentally Exposed to Manganese

Horacio Riojas-Rodríguez, Rodolfo Solís-Vivanco, Astrid Schilmann, Sergio Montes, Sandra Rodríguez, Camilo Ríos, Yaneth Rodríguez-Agudelo (October 2010) 118:1465–1470.

Although exposure to manganese (Mn) has been shown to be neurotoxic in adults, few studies have examined the potential for Mn to affect cognitive functions of environmentally exposed children. Riojas-Rodríguez et al. studied children 7–11 years of age from the Molango mining district in central Mexico; they determined Mn concentrations in hair (MnH) and blood (MnB) and evaluated intelligence using the revised version of the Wechsler Intelligence Scale for Children (WISC-R). Exposed children had significantly higher median MnH and MnB than nonexposed children. MnH was inversely associated with Verbal IQ, Performance IQ, and Total Scale IQ, but MnB was not significantly associated with Total Scale or Verbal IQ. Age and sex significantly modified associations of MnH, with the strongest inverse associations in young girls. There was little evidence of associations in boys at any age. The authors suggest that environmental exposure to airborne Mn is inversely associated with intellectual function in young school-age children, especially girls.

NEURODEVELOPMENTAL/NEUROBEHAVIORAL DISORDERS

Attention Deficit/Hyperactivity Disorder: A Focused Overview for Children's Environmental Health Researchers

Andréa Aguiar, Paul A. Eubig, Susan L. Schantz (December 2010) 118:1646–1653.

Attention deficit/hyperactivity disorder (ADHD) is the most frequently diagnosed childhood neurobehavioral disorder, but its etiology is not fully understood. Aguiar et al. provide a comprehensive overview of the diagnostic criteria for ADHD and review what is known about its biological basis and the neuropsychological functions affected by ADHD. The literature suggests that vigilance (sustained attention), response inhibition, and working memory are impaired in children with ADHD. In addition, there is less consistent evidence of impairments in alertness, cognitive flexibility, and planning as well as deficits in temporal information processing and altered responses to reinforcement. The authors conclude that there are substantial behavioral, neuroanatomical, and neurochemical differences between children diagnosed with ADHD and non-ADHD controls, and suggest that comparing neurobehavioral deficits associated with ADHD and exposures to environmental chemicals may help reveal common biological mechanisms and possibly identify environmental risk factors for ADHD.

NEWS | SCIENCE SELECTION

Parallel Outcomes: Comparing Effects of Environmental Contaminant Exposures with ADHD in Children

NEURODEVELOPMENTAL/NEUROBEHAVIORAL DISORDERS

Lead and PCBs as Risk Factors for Attention Deficit/Hyperactivity Disorder

Paul A. Eubig, Andréa Aguiar, Susan L. Schantz (December 2010) 118:1654–1667.

Eubig et al. review evidence from laboratory research and observational studies concerning neurobehavioral deficits that may be associated with attention deficit/hyperactivity disorder (ADHD) and exposures to environmental chemicals. The authors observe that deficits in attention and executive function associated with exposure to lead or polychlorinated biphenyls (PCBs) are similar to those reported in children diagnosed with ADHD. In particular, existing evidence suggests that lead may affect both attention and response inhibition, whereas PCBs may primarily affect response inhibition. In addition, the authors note that low-level lead exposure has been associated with a clinical diagnosis of ADHD, whereas studies of PCBs and clinically diagnosed ADHD have not been published. They conclude that exposures to environmental contaminants, including lead and PCBs, may be contributing to the increased prevalence of ADHD.

NEWS | SCIENCE SELECTION

Parallel Outcomes: Comparing Effects of Environmental Contaminant Exposures with ADHD in Children

NEURODEVELOPMENTAL/NEUROBEHAVIORAL DISORDERS

Exposure to Polyfluoroalkyl Chemicals and Attention Deficit/Hyperactivity Disorder in U.S. Children 12–15 Years of Age

Kate Hoffman, Thomas F. Webster, Marc G. Weisskopf, Janice Weinberg, Verónica M. Vieira (December 2010) 118:1762–1767.

Humans are widely exposed to polyfluoroalkyl chemicals (PFCs), and results of experimental studies on animals suggest that PFCs may be developmental neurotoxicants. Hoffman et al. used cross-sectional data from the National Health and Nutrition Examination Survey (NHANES) to estimate associations between serum levels of four PFCs [perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), and perfluorohexane sulfonic acid (PFHxS)] and attention deficit/hyperactivity disorder (ADHD) in 571 children 12–15 years of age, including 48 children with a previous diagnosis of ADHD. The authors report that serum levels of all four PFCs were positively associated with ADHD, and recommend additional studies to confirm these associations.

NEURODEVELOPMENTAL/NEUROBEHAVIORAL DISORDERS

PON1 and Neurodevelopment in Children from the CHAMACOS Study Exposed to Organophosphate Pesticides *in Utero*

Brenda Eskenazi, Karen Huen, Amy Marks, Kim G. Harley, Asa Bradman, Dana Boyd Barr, Nina Holland (December 2010) 118:1775–1781.

Maternal urinary concentrations of dialkyl phosphate (DAP) metabolites, a marker of *in utero* organophosphate (OP) pesticide exposure, were previously associated with poorer mental development and maternally reported symptoms consistent with pervasive developmental disorder (PDD) among 2-year-old children in the CHAMACOS study. Eskenazi et al. extended this research by examining modification of these association by paraoxonase 1 (PON1), an enzyme that detoxifies oxon derivatives of OP pesticides. The authors report that children with the *PON1*_{-108T} allele had poorer Bayley Mental Development Index scores and somewhat poorer Psychomotor Developmental Index scores, and that children were less likely to display symptoms of PDD when they or their mothers had higher PON1 activity. However, interactions between DAPs and *PON1* polymorphisms or activity were not statistically significant, and the authors conclude that additional research is needed to confirm whether PON1 modifies associations between *in utero* OP exposure and neurodevelopment.

NEURODEVELOPMENTAL/NEUROBEHAVIORAL DISORDERS

Intellectual Impairment in School-Age Children Exposed to Manganese from Drinking Water

Maryse F. Bouchard, Sébastien Sauvé, Benoit Barbeau, Melissa Legrand, Marie-Eve Brodeur, Thérèse Bouffard, Elyse Limoges, David C. Bellinger, Donna Mergler (January) 119:138–143.

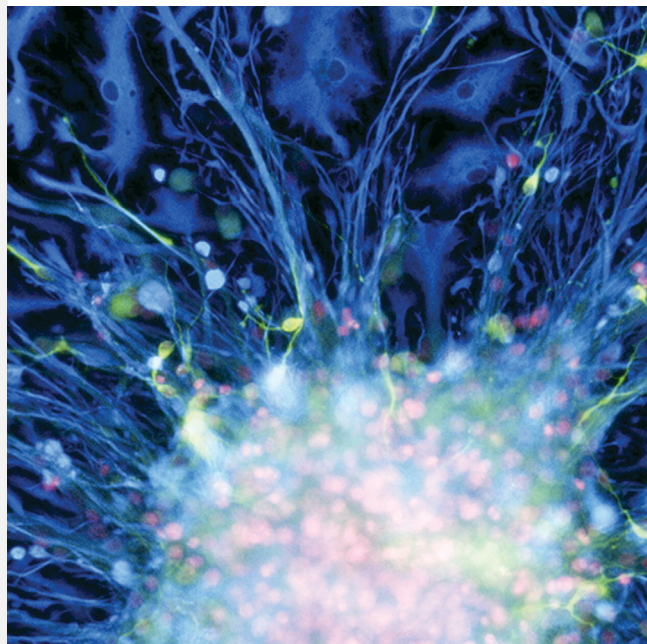
Manganese is an essential nutrient, but in excess, it can be a neurotoxicant. Despite the common occurrence of manganese in groundwater, the risks associated with this source of exposure are largely unknown. Bouchard et al. assessed the relationship between exposure to manganese from drinking water and children's intelligence quotient (IQ) and also examined manganese exposure from water consumption and diet. This cross-sectional study involved 362 children 6–13 years of age living in communities supplied by groundwater in southern Quebec, Canada. Manganese concentration was measured in home tap water (MnW) and children's hair (MnH); manganese intake from water ingestion and diet was estimated using a questionnaire. The authors report that MnH increased with manganese intake from water consumption but not with dietary manganese intake. Higher MnW and MnH were significantly associated with lower IQ scores. A 10-fold increase in MnW was associated with a decrease of 2.4 IQ points. There was a 6.2-IQ point difference between children in the lowest and highest MnW quintiles. MnW was also more strongly associated with Performance IQ than Verbal IQ. The authors conclude that their findings suggest that exposure to manganese at levels common in groundwater is associated with intellectual impairment in children.

RELATED ARTICLES

NEWS | FOCUS

Growing Knowledge: Using Stem Cells to Study Developmental Neurotoxicity

Kellyn S. Betts (October 2010) 118:A432–A437.



NEWS | FORUM

Measuring the Health Effects of Crop Burning

Tina Adler (November 2010) 118:A475.

PODCAST | A RESEARCHER'S PERSPECTIVE

Neurobehavioral Effects of Artificial Food Dyes

with Bernard Weiss (1 October 2010)

PODCAST | A RESEARCHER'S PERSPECTIVE

ADHD and Environmental Risk Factors

with Susan Schantz (1 December 2010)

NEURODEVELOPMENTAL/NEUROBEHAVIORAL DISORDERS

Hemoglobin, Lead Exposure, and Intelligence Quotient: Effect Modification by the *DRD2* Taq IA Polymorphism

Ananya Roy, Howard Hu, David C. Bellinger, Bhramar Mukherjee, Rama Modali, Khaja Nasaruddin, Joel Schwartz, Robert O. Wright, Adrienne S. Ettinger, Kavitha Palaniapan, Kalpana Balakrishnan (January) 119:144–149.

Anemia and lead exposure remain significant public health issues in many parts of the world, and they often occur together. Animal studies suggest that the dopamine D2 receptor (*DRD2*) mediates the effects of both lead and iron on cognition and behavior. Roy et al. tested the hypothesis that the *DRD2* Taq IA polymorphism modifies the effects of lead and hemoglobin on intelligence quotient (IQ) among children. Blood lead and hemoglobin were assessed in 717 children 3–7 years of age in Chennai, India, and IQ was determined using the Binet-Kamat scales of intelligence. The authors explored interactions between lead and hemoglobin, and *DRD2* Taq IA categories [homozygous variant (A1) vs. presence of wild-type allele (A2)]. The authors report that a one-unit increase in log blood lead was associated with a decrease of 9 IQ points in the homozygous-variant children compared with a decrease of 4 IQ points among those with the wild-type allele. Higher hemoglobin levels were associated with higher IQ in the children with the wild-type *DRD2* allele; however, in children homozygous for the variant allele, an increase of 1 g/dL hemoglobin was associated with a decrease in 1.8 points of IQ. The authors suggest that the *DRD2* Taq IA polymorphism disrupts the protective effect of hemoglobin on cognition and may increase the susceptibility to the deficits in IQ due to lead exposure.

NEURODEVELOPMENTAL/NEUROBEHAVIORAL DISORDERS

Developmental Neurotoxicants in E-Waste: An Emerging Health Concern

Aimin Chen, Kim N. Dietrich, Xia Huo, Shuk-mei Ho (April) 119:431–438.

Electronic waste (e-waste) is an emerging environmental health issue, especially in developing countries. Chen et al. pointed out that environmental exposure to suspected developmental neurotoxicants such lead, cadmium, chromium, polybrominated diphenyl ethers, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons found in e-waste is prevalent in areas where there is unregulated e-waste recycling. The potential risk of developmental neurotoxicity for exposed infants and children may therefore be high under such conditions. The authors also noted that e-waste exposures typically involve a mixture of heavy metals and persistent organic pollutants. Research is needed to understand the potential interaction of such chemicals as it relates to developmental neurotoxicity. More effective regulation of e-waste reclamation and pollution control measures are needed to protect vulnerable populations such as infants and children.

NEURODEVELOPMENTAL/NEUROBEHAVIORAL DISORDERS

Prenatal Exposure to Perfluorinated Chemicals and Behavioral or Coordination Problems at Age 7 Years

Chunyuan Fei, Jørn Olsen (April) 119:573–578.

Although exposure to high concentrations of perfluorinated compounds (PFCs) has been reported to be neurotoxic in studies using laboratory animals, the extent to which these chemicals might produce neurotoxicity in humans is not well established. Fei and Olsen investigated whether prenatal exposure to perfluorooctanoic acid (PFOA) or perfluorooctane sulfate (PFOS) is associated with behavioral or coordination difficulties in early childhood. The authors found no association between higher Strengths and Difficulties Questionnaire scores in children at 7 years of age and maternal levels of PFOA and PFOS measures around 8 weeks of gestation, nor did they see statistically significant association with motor coordination disorders. The findings suggest that under the conditions of their experiment, background levels of PFOA and PFOS are not associated with behavioral and motor coordination problems in childhood. Effects on other developmental end points, however, cannot be ruled out.

CHILDHOOD LEUKEMIA

Road Traffic and Childhood Leukemia: The ESCALE Study (SFCE)

Alicia Amigou, Claire Sermage-Faure, Laurent Orsi, Guy Leverger, André Baruchel, Yves Bertrand, Brigitte Nelken, Alain Robert, Gérard Michel, Geneviève Margueritte, Yves Perel, Françoise Mechinaud, Pierre Bordigoni, Denis Hémon, Jacqueline Clavel (April) 119:566–572.

Traffic is a source of environmental exposures, including benzene, which may be related to childhood leukemia. Amigou et al. assessed the relationship between exposure to road traffic exhaust fumes and the risk of childhood leukemia. The authors report that acute leukemia (AL) was significantly associated with estimates of traffic nitrogen dioxide (NO_2) concentration at the place of residence $> 27.7 \mu\text{g}/\text{m}^3$ compared with NO_2 concentration $< 21.9 \mu\text{g}/\text{m}^3$, and with the presence of a heavy-traffic road within 500 m compared with the absence of a heavy-traffic road in the same area. There was a significant association between AL and a high density of heavy-traffic roads within 500 m and a significant positive linear trend of the association of AL with the total length of heavy-traffic road within 500 m. The results suggest an association between living close to heavy-traffic roads and increased risk of childhood leukemia.

CANCER

Cancer Risks near Nuclear Facilities: The Importance of Research Design and Explicit Study Hypotheses

Steve Wing, David B. Richardson, Wolfgang Hoffmann (April) 119:417–421.

Wing et al. reviewed epidemiologic principles used to evaluate generic exposure–response associations and specific sources of exposure in studies of cancer risk near nuclear facilities. They also discussed their concerns about assumptions, formulation of testable hypotheses, and interpretation of evidence in previous research. The authors noted that advancement of knowledge in this area depends on testing specific hypotheses grounded in physical and biological mechanisms of exposure and susceptibility. They also noted that there is a need to consider sample size, adequately quantify exposure, ascertain cancer cases, and evaluate plausible confounders. The authors concluded that the next steps in advancing knowledge about cancer risks near nuclear facilities will require conducting studies of childhood cancer incidence, focusing on *in utero* and early childhood exposures, using specific geographic information, and considering pathways for transport and uptake of radionuclides.

BIRTH DEFECTS

Maternal Exposure to Ambient Levels of Benzene and Neural Tube Defects among Offspring: Texas, 1999–2004

Philip J. Lupo, Elaine Symanski, D. Kim Waller, Wenyaw Chan, Peter H. Langlois, Mark A. Canfield, Laura E. Mitchell (March) 119:397–402.

Previous studies have reported positive associations between maternal exposure to air pollutants and several adverse birth outcomes. However, no studies have examined the association between environmental levels of hazardous air pollutants, such as benzene, and neural tube defects (NTDs), a common and serious group of congenital malformations. Lupo et al. conducted a case–control study to assess the association between ambient air levels of benzene, toluene, ethylbenzene, and xylene and the prevalence of NTDs among offspring. The authors report that mothers living in census tracts with the highest benzene levels were more likely to have offspring with spina bifida than were women living in census tracts with the lowest levels. No significant associations were observed between anencephaly and benzene or between any of the NTD phenotypes and toluene, ethylbenzene, or xylene. These data contribute to the growing weight of evidence linking exposure to hazardous air pollutants such as benzene with adverse birth outcomes.

NEWS | SCIENCE SELECTION

Not Just for Workers: Maternal Exposure to Ambient Benzene Linked to Spina Bifida in Infants



BIRTH DEFECTS

Ambient Air Pollution and Risk of Congenital Anomalies: A Systematic Review and Meta-analysis

Martine Vrijheid, David Martinez, Sandra Manzanares, Payam Dadvand, Anna Schembari, Judith Rankin, Mark Nieuwenhuijsen (May) 119:598–606.

Vrijheid et al. systematically reviewed epidemiological studies on ambient air pollution and congenital anomalies and conducted meta-analyses for a number of air pollutant–anomaly combinations. They found 10 relevant studies, each of which reported an association between exposure to air pollutants and congenital anomalies. Nitrogen dioxide and sulfur dioxide exposures were associated with coarctation of the aorta and tetralogy of Fallot. Exposure to particulate matter $\leq 10 \mu\text{m}$ was associated with atrial septal defects. Meta-analyses found no statistically significant increase in other cardiac anomalies or oral clefts. The authors note that improvements in exposure assessment, outcome harmonization, assessment of other congenital anomalies, and mechanistic knowledge are needed.

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

Maternal Exposure to Nitrogen Dioxide during Pregnancy and Offspring Birth Weight: Comparison of Two Exposure Models

Johanna Lepeule, Fabrice Caiini, Sébastien Bottagisi, Julien Galineau, Agnès Hulin, Nathalie Marquis, Aline Bohet, Valérie Siroux, Monique Kaminski, Marie-Aline Charles, Rémy Slama (October 2010) 118:1483–1489.

Studies of the effects of air pollutants on birth weight often assess exposure with permanent air quality monitoring station (AQMS) networks, which are known to have poor spatial resolution. Lepeule et al. compared two exposure models: one based on the nearest AQMS, and one temporally adjusted geostatistical (TAG) model, which has a finer spatial resolution. The authors compared the models in terms of both exposure estimates and associations with birth weight. Variations in exposure were mostly due to spatial rather than temporal considerations in both models; temporal variation was greater in the TAG model than in the nearest-AQMS model. The concordance between nitrogen dioxide (NO₂) exposure estimates in the two models was modest when a 5-km buffer was considered. This concordance was stronger if the analysis was restricted to women living closer (≤ 2 km) to an AQMS. When exposure was coded as a continuous term, associations with birth weight for the TAG model were consistent with those obtained in analyses based on exposure estimated from the nearest-AQMS model. The authors conclude that models of exposure to background NO₂ concentrations based on data from the nearest AQMS may contain large errors in estimated exposure, but in some instances, these errors have little impact on the relationship between exposure and birth weight.

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

Genetic, Biochemical, and Environmental Factors Associated with Pregnancy Outcomes in Newborns from the Czech Republic

Pavel Rossner Jr., Nana Tabashidze, Miroslav Dostal, Zuzana Novakova, Irena Chvatalova, Milada Spatova, Radim J. Sram (February) 119:265–271.

To determine whether oxidative damage to placental DNA can result in adverse pregnancy outcomes, including intrauterine growth restriction (IUGR) and low birth weight (LBW), Rossner et al. investigated associations between pregnancy outcomes and levels of 8-oxo-7,8-dihydro-2'-deoxyguanosine (8-oxodG), a marker of oxidative DNA damage, in placental DNA; exposure to air pollutants during pregnancy; and genetic polymorphisms in selected genes. The authors studied IUGR- or LBW-affected or normal weight newborns from two regions of the Czech Republic with different levels of air pollution. They found nonsignificantly elevated 8-oxodG levels in the IUGR-affected group and slightly elevated levels in the LBW-affected group. They also identified single-nucleotide polymorphisms associated with 8-oxodG levels, IUGR, and LBW. Both 8-oxodG levels in placental DNA and LBW were associated with exposure to particulate matter < 2.5 μm; however, the role of air pollutants in the risk of adverse pregnancy outcomes appeared less important than other factors. The authors conclude that levels of 8-oxodG in placental DNA are associated with IUGR and LBW. Sex of the newborn, gestational age, maternal smoking, and genetic polymorphisms in the promoter region of the *MBL2* gene may affect LBW incidence.

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

Maternal Exposure to Air Pollution and Birth Outcomes

Ebba Malmqvist, Anna Rignell-Hydbom, Håkan Tinnerberg, Jonas Björk, Emilie Stroh, Kristina Jakobsson, Ralf Rittner, Lars Rylander (April) 119:553–558.

Malmqvist et al. conducted a birth cohort study to determine whether low-level exposure to air pollution was associated with premature birth and fetal growth and whether there were sex-specific effects. The authors reported an increased association of risk for babies being small for gestational age (SGA) and exposure to nitrogen oxides (NO_x) after adjusting for maternal age, smoking, sex, and year of birth. After additional adjustment for maternal country of origin and parity, however, the increase was no longer statistically significant. In subgroup analysis when highest and lowest NO_x quartiles were compared, there was still an increased risk for SGA for baby girls, and an increased risk also if mothers had not changed residency during pregnancy. The confounders with the greatest impact on SGA were parity and country of origin.

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

Ambient Carbon Monoxide and Fine Particulate Matter in Relation to Preeclampsia and Preterm Delivery in Western Washington State

Carole B. Rudra, Michelle A. Williams, Lianne Sheppard, Jane Q. Koenig, Melissa A. Schiff (June) 119:886–892.

Preterm delivery and preeclampsia are common adverse pregnancy outcomes that have been inconsistently associated with ambient air pollutant exposures. Rudra et al. prospectively examined relations between exposures to ambient carbon monoxide (CO) and fine particulate matter [particulate matter ≤ 2.5 μm in aerodynamic diameter (PM_{2.5})] and risks of preeclampsia and preterm delivery. They used data collected over a 10-year period from women who delivered liveborn infants. Ambient CO and PM_{2.5} exposures were predicted using regression models based on regional air pollutant monitoring data. Predicted periconceptional CO exposure was significantly associated with preeclampsia after adjustment for maternal characteristics and season of conception. However, further adjustment for year of conception essentially nullified the association. Associations between PM_{2.5} and preeclampsia were nonsignificant and weaker than associations estimated for CO, and neither air pollutant was strongly associated with preterm delivery. Patterns were similar across all exposure windows.

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

Serum Concentrations of Polychlorinated Biphenyls in Relation to *in Vitro* Fertilization Outcomes

John D. Meeker, Arnab Maity, Stacey A. Missmer, Paige L. Williams, Shruthi Mahalingaiah, Shelley Ehrlich, Katharine F. Berry, Larisa Altshul, Melissa J. Perry, Daniel W. Cramer, Russ Hauser (July) 119:1010–1016.

Exposure to polychlorinated biphenyls (PCBs) has been associated with adverse reproductive health outcomes, including reduced fecundability and increased risk of pregnancy loss. To explore the relationship between serum PCB concentrations and early pregnancy loss among a cohort of 765 women undergoing *in vitro* fertilization (IVF), Meeker et al. measured concentrations of PCB congeners in serum samples collected during IVF/intracytoplasmic sperm injection cycles. PCB-153 was the congener present in the highest concentration. Increasing quartiles of PCB-153 and the sum of all measured PCB congeners were associated with significantly elevated dose-dependent odds of failed implantation, but no statistically significant associations were observed between PCBs and chemical pregnancy or spontaneous abortion. Serum PCB concentrations at levels similar to those in the United States general population were associated with failed implantation among women undergoing IVF. These findings may help explain previous reports of reduced fecundability among women exposed to PCBs.

▼ NEWS | SCIENCE SELECTION

PCBs May Impede IVF Success: Failed Embryo Implantation Linked to Exposure

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

The International Collaboration on Air Pollution and Pregnancy Outcomes: Initial Results

Jennifer D. Parker, David Q. Rich, Svetlana V. Glinianaia, Jong Han Leem, Daniel Wartenberg, Michelle L. Bell, Matteo Bonzini, Michael Brauer, Lyndsey Darrow, Ulrike Gehring, Nelson Gouveia, Paolo Grillo, Eunhee Ha, Edith H. van den Hooven, Bin Jalaludin, Bill M. Jesdale, Johanna Lepeule, Rachel Morello-Frosch, Geoffrey G. Morgan, Rémy Slama, Frank H. Pierik, Angela Cecilia Pesatori, Sheela Sathyanarayana, Juhee Seo, Matthew Strickland, Lillian Tamburic, Tracey J. Woodruff (July) 119:1023–1028.

Previous research suggests that results from studies on the relationship between air pollution and adverse birth outcomes are difficult to interpret because of differences in study design. The International Collaboration on Air Pollution and Pregnancy Outcomes was formed to understand how differences in research methods might contribute to variations in findings. Parker et al. (p. 1023) initiated a study to assess the ability of geographically diverse research groups to analyze data sets using a common protocol and to perform location-specific analyses of air pollution effects on birth weight using a standardized statistical approach. Fourteen research groups from nine countries participated. A protocol was developed to estimate odds ratios for the association between particulate matter $\leq 10 \mu\text{m}$ in aerodynamic diameter (PM_{10}) and low birth weight (LBW) among term births, adjusted first for socioeconomic status and then for additional location-specific variables. Despite the use of a common statistical approach, relationships between PM_{10} and LBW among study locations remained variable. A more detailed meta-analysis and use of more complex protocols for future analysis may uncover reasons for heterogeneity across locations.

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

Urinary Biomarkers of Prenatal Atrazine Exposure and Adverse Birth Outcomes in the PELAGIE Birth Cohort

Cécile Chevrier, Gwendolina Limon, Christine Monfort, Florence Rouget, Ronan Garlantézec, Claire Petit, Gaël Durand, Sylvaine Cordier (July) 119:1034–1041.

Chevrier et al. assessed the association between adverse birth outcomes and urinary biomarkers of prenatal atrazine (triazine and chloroacetanilide herbicides) exposure, taking into account exposure to other herbicides used on corn crops. They collected maternal urine samples ($n = 3,399$) using a case-cohort design nested in a prospective birth cohort [the PELAGIE (Perturbateurs endocriniens: Étude Longitudinale sur les Anomalies de la Grossesse, l'Infertilité et l'Enfance)] to examine pesticide exposure biomarkers before the 19th week of gestation. The authors report quantifiable levels of atrazine or atrazine mercapturate in urine samples from 5.5% of pregnant women sampled, and dealkylated and hydroxylated triazine metabolites in 20% and 40% of samples, respectively. The presence of atrazine or a specific atrazine metabolite was associated with fetal growth restriction and small head circumference for sex and gestational age. Major congenital anomalies were not associated with levels of atrazine or its specific metabolites. Head circumference was inversely associated with the presence of urinary metolachlor. Evidence of associations with adverse birth outcomes raises concern about the continued use of these chemicals.

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

Air Pollution and Stillbirth: A Population-Based Case–Control Study in Taiwan

Bing-Fang Hwang, Yungling Leo Lee, Jouni J.K. Jaakkola (September) 119:1345–1349.

There is limited evidence suggesting that prenatal exposure to ambient air pollutants may increase the risk of stillbirth. Hwang et al. studied associations between exposure to ambient air pollutants and stillbirth with special reference to the assessment of gestational periods when the fetus is most susceptible. Stillbirth was associated with increased sulfur dioxide (SO_2) in the first trimester, particularly among preterm births. Stillbirth was also associated with an increase in PM_{10} (particulate matter $\leq 10 \mu\text{m}$ in aerodynamic diameter) during the first and second month of gestation and, as for SO_2 associations, appeared to be restricted to preterm births. These results indicate that exposure to outdoor air SO_2 and PM_{10} may be associated with an increased risk of stillbirth, especially among preterm births, and that the most susceptible time period for exposure is during the first trimester of gestation.

AUTISM

Urinary Porphyrin Excretion in Neurotypical and Autistic Children

James S. Woods, Sarah E. Armel, Denise I. Fulton, Jason Allen, Kristine Wessels, P. Lynne Simmonds, Doreen Granpeesheh, Elizabeth Mumper, J. Jeffrey Bradstreet, Diana Echeverria, Nicholas J. Heyer, James P.K. Rooney (October 2010) 118:1450–1457.

Increased urinary concentrations of pentacarboxylporphyrins, precoproporphyrins and coproporphyrins have been associated with prolonged mercury (Hg) exposure in adults. Comparable increases in urinary porphyrins have been attributed to Hg exposure in children with autism. Woods et al. compared urinary porphyrin concentrations in neurotypical children and autistic children of the same age. They also examined the association between urinary porphyrin levels and past or current Hg exposure in children with autism. Children 2–12 years of age were categorized into one of three groups: autistic, pervasive developmental disorder-not otherwise specified (PDD-NOS), and neurotypical. Elevated urinary concentrations of coproporphyrin, hexacarboxylporphyrin, and pentacarboxylporphyrin were significantly associated with autism but not with PDD-NOS. Hg exposures were comparable between the two diagnostic groups, and a urinary porphyrin pattern did not appear to be consistent with that seen in Hg-exposed adults. The authors conclude that disordered porphyrin metabolism is a characteristic of autism.

AUTISM

Residential Proximity to Freeways and Autism in the CHARGE Study

Heather E. Volk, Irva Hertz-Picciotto, Lora Delwiche, Fred Lurmann, Bob McConnell (June) 119:873–877.

Little is known about environmental causes and contributing factors for autism. Volk et al. examined the association between autism and residence proximity to freeways and major roadways during pregnancy and near the time of delivery. Maternal residence at the time of delivery was more likely to be near a freeway for autism cases than for controls. Autism was also associated with residential proximity to a freeway during the third trimester. Living near a freeway, but not near other major roads at birth, was associated with autism. More research is needed to provide a linkage between actual exposure to air pollutants from traffic emissions and autism.

INFECTIONS

Association between Rainfall and Pediatric Emergency Department Visits for Acute Gastrointestinal Illness

Patrick Drayna, Sandra L. McLellan, Pippa Simpson, Shun-Hwa Li, Marc H. Gorelick (October 2010) 118:1439–1443.

Microbial water contamination after periods of heavy rainfall has been well documented, and there is concern that it may affect public health. Drayna et al. conducted a retrospective time-series analysis of pediatric emergency department (ED) visits for acute gastrointestinal illness (AGI) and daily rainfall totals during the study period (2002–2007). The authors report a significant association between rainfall and pediatric ED visits for AGI, suggesting a waterborne component of disease transmission in this population. The observed increase in ED visits for AGI occurred in the absence of any disease outbreaks reported to public health officials in the region, suggesting that rainfall-associated illness may be underestimated.

INFECTIONS

Impact of a Citywide Sanitation Program in Northeast Brazil on Intestinal Parasites Infection in Young Children

Mauricio L. Barreto, Bernd Genser, Agostino Strina, Maria Gloria Teixeira, Ana Marluca O. Assis, Rita F. Rego, Carlos A. Teles, Matildes S. Prado, Sheila M.A. Matos, Neuza M. Alcântara-Neves, Sandy Cairncross (November 2010) 118:1637–1642.

The importance of an uncontaminated water supply and proper sanitation in controlling enteric infections, as well as contributing to poverty eradication, has been recognized by the international community. Although sanitation appears to be no less effective as a public health measure than water supply improvements, targets for improving sanitation worldwide are not being met, and there is a lack of rigorous evidence demonstrating the effectiveness of sanitation programs in preventing disease in large populations. Barreto et al. evaluated the impact of a sanitation program implemented throughout the city of Salvador in Bahia State, Brazil, on infection with *Ascaris lumbricoides*, *Trichuris trichuria*, and *Giardia duodenalis* in two cross-sectional studies of children age 1–4 years. The prevalence of infection was reduced after intervention, and most of this reduction appeared to be explained by the increased coverage of each neighborhood by the sewage system constructed during the intervention. The authors conclude that their data support the implementation of sanitation programs at the city or regional level and that they are more effective than programs that target changes at the domestic or household level.

INFECTIONS

Air Pollution and Emergency Department Visits for Otitis Media: A Case-Crossover Study in Edmonton, Canada

Roger Zemek, Mieczysław Szyszkowicz, Brian H. Rowe (November 2010) 118:1631–1636.

Otitis media (OM) is one of the most common early childhood infections, resulting in an enormous economic burden to the health care system through unscheduled doctor visits and antibiotic prescriptions. Zemek et al. investigated the association between ambient air pollution exposure and emergency department (ED) visits for OM using 10 years of ED data from Edmonton, Alberta, Canada, and measures of carbon monoxide (CO), nitrogen dioxide (NO₂), ozone (O₃), sulfur dioxide, and particulate matter (PM; median aerometric diameter ≤ 10 and 2.5 μm). After applying a time-stratified case-crossover technique to analyze the associations between ambient air pollution and health outcomes, the authors observed positive associations between ED visits for OM and increased CO and NO₂ levels. The strongest associations were observed in the warmer months (April–September) in girls and all children exposed to CO and NO₂. The authors conclude that their data support the hypothesis that ED visits for OM are associated with ambient air pollution.

INFECTIONS

Global Influenza Seasonality: Reconciling Patterns across Temperate and Tropical Regions

James Tamerius, Martha I. Nelson, Steven Z. Zhou, Cécile Viboud, Mark A. Miller, Wladimir J. Alonso (April) 119:439–445.

Despite the significant disease burden of the influenza virus in humans, we still do not fully understand the basis for its seasonality. Past observations that influenza epidemics occur in the winter across temperate climates have led to the perception that cool and dry conditions are a necessary, and possibly sufficient, condition for influenza epidemics. Recent reports of substantial levels of influenza virus activity and well-defined seasonality in tropical regions, however, have called into question these assumptions. Tamerius et al. examined the scientific evidence for mechanisms that potentially explain the complex seasonal patterns of influenza disease activity observed globally. The authors concluded that the central questions in influenza seasonality remain unresolved. Future research is particularly needed in tropical localities where understanding of seasonality remains poor. A more complete understanding of the environmental factors that drive influenza circulation may lead to a better understanding of how the dynamics of influenza will be affected at regional levels by global climate change.

INFECTIONS

Arsenic Exposure in Pregnancy Increases the Risk of Lower Respiratory Tract Infection and Diarrhea during Infancy in Bangladesh

Anisur Rahman, Marie Vahter, Eva-Charlotte Ekström, Lars-Åke Persson (May) 119:719–724.

Associations between prenatal arsenic exposure and increased risk of infant mortality have been reported previously. An increase in infectious diseases has been proposed as the underlying cause of these associations, but there is no epidemiological research to support the hypothesis. Rahman et al. evaluated the association between arsenic exposure in pregnancy and causes of morbidity during infancy. They assessed arsenic exposure by measuring the concentrations of metabolites of inorganic arsenic in maternal urine samples collected at gestational weeks 8 and 30. Information on symptoms of lower respiratory tract infection and diarrhea in infants was collected during monthly home visits. The authors conclude that arsenic exposure during pregnancy was associated with increased morbidity due to infectious diseases during infancy.

NEWS | SCIENCE SELECTION

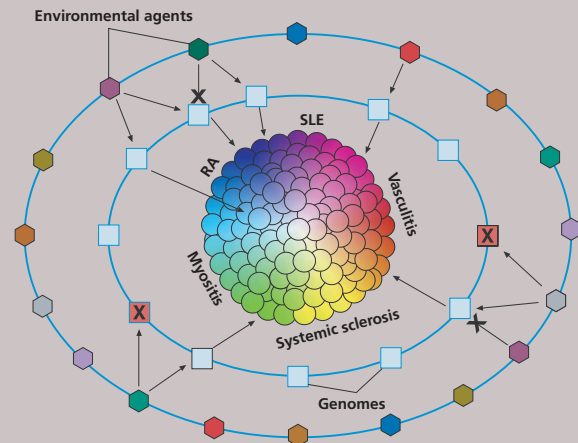
Arsenic and Infectious Disease: A Potential Factor in Morbidity among Bangladeshi Children

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Questions Persist: Environmental Factors in Autoimmune Disease

Charles W. Schmidt (June) 119:A248–A253.



Gene–Environment Interactions and Autoimmune Disease: One Hypothesis

In the elemental disorder hypothesis, autoimmune diseases are viewed as collections of many individual phenotypes, each defined by a unique set of symptoms, signs, and laboratory findings. This figure uses the example of systemic rheumatic diseases, a subset of autoimmune diseases, to conceptualize how a variety of disease phenotypes may result from different gene–environment interactions.

Each sphere represents a disease phenotype, each square represents an individual's genome, and each hexagon represents a particular environmental exposure. In this hypothesis, some combinations of genomes and environmental exposures lead to certain disease phenotypes, whereas other combinations might not. In still other cases, either an environmental factor or a genome may confer protection against developing disease, indicated here by an X.

RA = rheumatoid arthritis; SLE = systemic lupus erythematosus.
Source: Gourley M, Miller FW. Mechanisms of disease: environmental factors in the pathogenesis of rheumatic disease. *Nat Clin Pract Rheumatol* 3(3):172–180 (2007); doi:10.1038/ncprheum0435. Reprinted with permission.

FETAL OR EARLY-LIFE EXPOSURES CONTRIBUTING TO ADULT DISEASE

Proton Magnetic Resonance Spectroscopy in Adults with Childhood Lead Exposure

Kim M. Cecil, Kim N. Dietrich, Mekibib Altaye, John C. Egelhoff, Diana M. Lindquist, Christopher J. Brubaker, Bruce P. Lanphear (March) 119:403–408.

Childhood lead exposure can adversely affect neurodevelopment. Because few studies have examined changes in human brain metabolism that may be associated with cognitive and behavioral outcomes, Cecil et al. examined the relationship between mean childhood blood lead levels and *in vivo* brain metabolite concentrations in adult participants from the Cincinnati Lead Study ($n = 159$), using proton magnetic resonance spectroscopy. Increases in mean childhood blood lead levels were associated with a decrease in *N*-acetyl aspartate, creatine, and phosphocreatine levels in the basal ganglia; decreased choline (Cho) concentrations in the cerebellar hemisphere; decreased glutamate and glutamine (GLX) levels in the vermis; decreased Cho and GLX concentrations in parietal white matter; and decreased Cho concentrations in frontal white matter. The authors conclude that sustained childhood lead exposure produces persistent patterns of neural dysfunction, some of which may be associated with structural alterations in the brain.

FETAL OR EARLY-LIFE EXPOSURES CONTRIBUTING TO ADULT DISEASE

Investigating Intergenerational Differences in Human PCB Exposure due to Variable Emissions and Reproductive Behaviors

Cristina L. Quinn, Frank Wania, Gertje Czub, Knut Breivik (May) 119:641–646.

Quinn et al. used the time-variant mechanistic model CoZMoMAN to calculate human bioaccumulation of PCBs and estimate prenatal, postnatal, and lifetime polychlorinated biphenyl (PCB) exposures for women at different ages. They then evaluated the impact of reproductive behaviors such as age of childbearing, parity, and breast-feeding on intergenerational differences in exposure. The authors report that a mother's reproductive history has a greater influence on the prenatal and postnatal exposures of her children than it does on her own cumulative lifetime exposure. A child's birth order also appears to have a strong influence on their prenatal exposure, whereas postnatal exposure is determined by the type of milk (breast milk or formula) fed to the infant. Prenatal PCB exposure appears to be delayed relative to the time of PCB emissions, particularly among those born after the phase-out of PCB production. These results indicate that the health repercussions of environmental PCBs can be expected to persist for several decades.

NEWS | SCIENCE SELECTION

Passing Down Pollution: Calculating Intergenerational Exposure to PCBs

FETAL OR EARLY-LIFE EXPOSURES CONTRIBUTING TO ADULT DISEASE

Perinatal Exposure to Low Doses of Dioxin Can Permanently Impair Human Semen Quality

Paolo Mocarelli, Pier Mario Gerthoux, Larry L. Needham, Donald G. Patterson Jr., Giuseppe Limonta, Rosanna Falbo, Stefano Signorini, Maria Bertona, Carla Crespi, Cecilia Sarto, Paul K. Scott, Wayman E. Turner, Paolo Brambilla (May) 119:713–718.

Young men in some industrialized areas have reportedly experienced a decrease in semen quality in recent decades. Mocarelli et al. examined the effects of *in utero* or perinatal dioxin exposure on sperm quality and reproductive hormones in 78 men 18–26 years of age. Thirty-nine of the men were born between 1977 and 1984 to mothers exposed to dioxin after the accident in Seveso, Italy; these men were compared with men born to mothers exposed only to background dioxin. Maternal dioxin levels at conception were extrapolated from the concentrations measured in 1976 serum samples. The authors report that men exposed to dioxin throughout the perinatal period had reduced semen quality and sperm counts, increased concentrations of follicle-stimulating hormone, and decreased inhibin B concentrations.

NEWS | SCIENCE SELECTION

Window for Dioxin Damage: Sperm Quality in Men Born after the Seveso Disaster

FETAL OR EARLY-LIFE EXPOSURES CONTRIBUTING TO ADULT DISEASE

I-131 Dose Response for Incident Thyroid Cancers in Ukraine Related to the Chernobyl Accident

Alina V. Brenner, Mykola D. Tronko, Maureen Hatch, Tetyana I. Bogdanova, Valery A. Oliynik, Jay H. Lubin, Lydia B. Zablotska, Valery P. Tereschenko, Robert J. McConnell, Galina A. Zamotaeva, Patrick O'Kane, Andre C. Bouville, Ludmila V. Chaykovskaya, Ellen Greenebaum, Ihor P. Paster, Victor M. Shpak, Elaine Ron (July) 119:933–939.

Current knowledge about Chernobyl-related thyroid cancer risks comes from ecological studies based on grouped doses, case-control studies, and studies of prevalent cancers. Brenner et al. evaluated the dose-response relationship for incident thyroid cancers using measurement-based individual iodine-131 (I-131) thyroid dose estimates in a prospective analytic cohort study. The cohort consisted of individuals < 18 years of age on the day of the incident in 1986 and who resided in one of the three contaminated oblasts (states) of Ukraine ($n = 12,514$). Participants underwent up to four thyroid screening examinations between 1998 and 2007. I-131 thyroid doses were estimated based on individual radioactivity measurements taken within 2 months after the accident, environmental transport models, and interview data. Sixty-five incident thyroid cancers were diagnosed during the second through fourth screenings. The dose-response relationship was consistent with linearity on relative and absolute scales, although the excess relative risk model described data better than did the excess absolute risk model. I-131-related thyroid cancer risks persisted for two decades after exposure with no evidence of decrease during the observation period. The radiation risks, although smaller, are compatible with those of retrospective and ecological post-Chernobyl studies. Additional studies will be required to determine more accurately the excess risk over time following the Chernobyl incident.

NEWS | SCIENCE SELECTION

Thyroid Cancer after Chernobyl: Increased Risk Persists Two Decades after Radioiodine Exposure

FETAL OR EARLY-LIFE EXPOSURES CONTRIBUTING TO ADULT DISEASE

Environmental Exposures and Mammary Gland Development: State of the Science, Public Health Implications, and Research Recommendations

Ruthann A. Rudel, Suzanne E. Fenton, Janet M. Ackerman, Susan Y. Euling, Susan L. Makris (August) 119:1053–1061.

Perturbations in mammary gland (MG) development may increase risk for later adverse effects, including lactation impairment, gynecomastia (in males), and breast cancer. Based on their review of the literature, Rudel et al. make several recommendations for evaluating MG development. Normal MG development and MG carcinogenesis demonstrate temporal, morphological, and mechanistic similarities among test animal species and humans. Diverse chemicals, including many not considered estrogenic, can alter MG development in rodents. In some toxicological studies, altered MG development is the most sensitive endocrine end point. Research has shown that early life environmental exposures can alter MG development, disrupt lactation, and increase susceptibility to breast cancer. The authors conclude that assessment of MG development should be incorporated in chemical test guidelines and considered in the risk assessment process.

ANTIBODIES AND VACCINATIONS

Serum Concentrations of Antibodies Against Vaccine Toxoids in Children Exposed Perinatally to Immunotoxicants

Carsten Heilmann, Esben Budtz-Jørgensen, Flemming Nielsen, Birger Heinzow, Pål Weihe, Philippe Grandjean (October 2010) 118:1434–1438.

Previous research found an association between decreased antibody response to diphtheria and tetanus toxoid in children and early postnatal exposure to polychlorinated biphenyls (PCBs). In a follow-up study, Heilmann et al. used a cohort formed in the Faroe Islands during 1999–2001 to assess serum antibody concentrations in children at 5 years (before and after a booster vaccination) and at 7 years of age. Total PCB concentrations were measured in serum from the children (at 5 and 7 years and in a subset at 18 months) and in maternal serum during pregnancy and postpartum milk samples. At the 5-year age point, before the booster vaccination, antidiphtheria antibody concentrations were inversely associated with PCB concentrations in milk and serum PCBs at 18 months of age. Results also suggested that concentrations of antibodies against both diphtheria and tetanus toxoids at age 7 years were inversely associated with PCB concentrations at age 18 months. Mercury exposure parameters showed variable associations with the antibody concentrations with no clear pattern. The authors conclude that developmental PCB exposure is associated with immunotoxic effects that may alter the effectiveness of diphtheria and tetanus vaccinations.

NEWS | SCIENCE SELECTION

Diminished Protection? Early Childhood PCB Exposure and Reduced Immune Response to Vaccinations

HORMONAL DEVELOPMENT

Association between Lead and Cadmium and Reproductive Hormones in Peripubertal U.S. Girls

Audra L. Gollenberg, Mary L. Hediger, Peter A. Lee, John H. Himes, Germaine M. Buck Louis (December 2010) 118:1782–1787.

Lead (Pb) and cadmium (Cd) are reproductive toxicants that may disrupt hormone production if exposure occurs during critical windows of development. Gollenberg et al. examined associations between blood Pb and urinary Cd concentrations and serum luteinizing hormone and inhibin B levels in 705 girls 10–11 years of age in the Third National Health and Nutrition Examination Survey (NHANES 1988–1994). Blood Pb was relatively low in the population overall, but concentrations were inversely associated with inhibin B, a marker of pubertal onset, with stronger associations when urinary Cd was also increased. Based on their findings, the authors conclude that Pb and Cd may delay the onset of puberty or alter its progression in young girls.

NEWS | SCIENCE SELECTION

Do Metals Meddle with Puberty in Girls? Lead, Cadmium, and Altered Hormone Levels

HEAVY METALS (E.G., LEAD, MERCURY)

Evaluating and Regulating Lead in Synthetic Turf

Gregory Van Ulirsch, Kevin Gleason, Shawn Gerstenberger, Daphne B. Moffett, Glenn Pulliam, Tariq Ahmed, Jerald Fagliano (October 2010) 118:1345–1349.

A recreational field in Newark, New Jersey, was closed in 2007 because lead concentrations found in synthetic turf fibers and in surface dust exceeded hazard criteria. Consequently, public health professionals across the country began testing synthetic turf to determine whether it represented a lead hazard. Data collected from recreational fields and child care centers indicated lead in synthetic turf fibers and dust at concentrations that exceed the Consumer Product Safety Improvement Act of 2008 statutory lead limit of 300 mg/kg for consumer products intended for use by children and the U.S. Environmental Protection Agency's lead-dust hazard standard of 40 µg/ft² for floors. The authors conclude that synthetic turf can deteriorate to form dust containing lead at levels that may pose a risk to children. Currently, no standardized methods exist to test for lead in synthetic turf or to assess lead. Ulirsch et al. summarize data on lead in fibers and turf-derived dust and discuss risk assessment uncertainties. They also note the need for regulatory agencies to develop standardized methods for assessing lead in synthetic turf and recommend an interim approach for sampling, interpreting results, and taking health-protective actions.

HEAVY METALS (E.G., LEAD, MERCURY)

Maternal Low-Level Lead Exposure and Fetal Growth

Motao Zhu, Edward F. Fitzgerald, Kitty H. Gelberg, Shao Lin, Charlotte M. Druschel (October 2010) 118:1471–1475.

Despite the banning of lead in gasoline, the general population continues to be exposed to this metal. Lead in pregnant women can readily cross the placenta and enter fetal blood circulation, making the fetus susceptible to lead poisoning. Evidence for an association between relatively low-level maternal blood lead (PbB) levels (< 10 µg/dL) and fetal growth has been inconclusive. Zhu et al. linked New York State Heavy Metals Registry records of women having PbB measurements with birth certificates to identify mother–infant pairs in a retrospective cohort study. The authors found no significant association between PbB and preterm birth or small-for-gestational age measures. However, among pregnant women with PbB levels < 10 µg/dL, PbB was inversely associated with birth weight, with little evidence of a threshold. These results are important because pregnant women continue to be exposed to relatively low levels of lead and because of the continued controversy regarding the recommended action level for maternal blood lead.

HEAVY METALS (E.G., LEAD, MERCURY)

Arsenic-Associated Oxidative Stress, Inflammation, and Immune Disruption in Human Placenta and Cord Blood

Sultan Ahmed, Sultana Mahabbat-e Khoda, Rokeya Sultana Rekha, Renee M. Gardner, Syeda Shegufta Ameer, Sophie Moore, Eva-Charlotte Ekström, Marie Vahter, Rubhana Raqib (February) 119:258–264.

Chronic exposure to inorganic As (iAs) through elevated concentrations in drinking water is a major environmental health hazard throughout the world. In women exposed to As during pregnancy, iAs is readily transferred to the fetus, reportedly causing increased rates of fetal loss, preterm births, and neonatal mortality, as well as decreased birth weight. However, the mechanisms of As-induced developmental toxicity are poorly understood. Some investigators have suggested that fetal loss and low birth weight may be a consequence of increased oxidative stress following exposure to As. Ahmed et al. estimated the effects of As exposure on immune markers in the placenta and cord blood and their relationship to oxidative stress. The authors determined As concentrations in maternal urine samples collected twice during pregnancy (at gestational weeks 8 and 30), and at delivery they assessed placenta and cord blood for immune and inflammatory markers, as well as for an indicator of oxidative stress. The authors report that exposure to As during pregnancy appeared to enhance placental inflammatory responses (in part by increasing oxidative stress), reduce placental T cells, and alter cord blood cytokines. These findings support the possibility that effects of As on immune function could be associated with fetal loss and low birth weight.

HEAVY METALS (E.G., LEAD, MERCURY)

Bioavailability of Cadmium in Inexpensive Jewelry

Jeffrey D. Weidenhamer, Jennifer Miller, Daphne Guinn, Janna Pearson (July) 119:1029–1033.

High cadmium (Cd) concentrations have been found recently in some inexpensive jewelry. There is no formal regulatory standard for Cd in jewelry, and few data exist regarding potential exposures. Weidenhamer et al. evaluated the bioavailability of Cd in components of 57 jewelry items found to contain high levels of Cd. Bioavailability was evaluated by placing items *a*) in a saline solution at 37°C for 6 hr to simulate exposures from mouthing of jewelry items; or *b*) into dilute hydrochloric acid (HCl) at 37°C for 6–96 hr to approximate conditions after swallowing a jewelry item. To determine the effect of breaching the outer plating on bioavailability, damaged pieces of selected samples were also extracted by both methods. The 6-hr saline extraction yielded as much as 2,200 µg Cd, and 24-hr dilute HCl extraction yielded a maximum of > 20,000 µg Cd. Leaching of Cd in dilute HCl increased linearly over 6–96 hr, indicating potential for increasing harm the longer an item remains in an acidic environment. Damage to jewelry by breaching the outer plating generally, but not always, increased Cd presence, and bioavailability did not correlate directly with Cd content. These results indicate the potential for Cd exposures to individuals who mouth or accidentally swallow high-Cd jewelry items.

PESTICIDES

Assessing Children's Dietary Pesticide Exposure: Direct Measurement of Pesticide Residues in 24-Hr Duplicate Food Samples

Chensheng Lu, Frank J. Schenck, Melanie A. Pearson, Jon W. Wong
(November 2010) 118:1625–1630.

In response to calls for more direct measurements of pesticide residues in foods consumed by children, and to compare direct measures of pesticide residues in foods representing actual consumption with those reported by the U.S. Department of Agriculture Pesticide Data Program, Lu et al. measured pesticide residues in 239 24-hr duplicate food samples collected from 46 children in the Children's Pesticide Exposure Study (CPS). Parents collected duplicate food samples of all conventional fruits, vegetables, and fruit juices consumed by their children, and individual or composite food items were analyzed for residues of organophosphate (OP) and pyrethroid insecticides. The authors report that 14% and 5% of food samples contained at least one OP or pyrethroid insecticide, respectively. They also detected a total of 11 OP insecticides and 3 pyrethroid insecticides. The authors conclude that findings support the need to reduce the presence of these pesticides in the food supply.

PESTICIDES

Organophosphate Pesticide Exposure and Attention in Young Mexican-American Children: The CHAMACOS Study

Amy R. Marks, Kim Harley, Asa Bradman, Katherine Kogut, Dana Boyd Barr, Caroline Johnson, Norma Calderon, Brenda Eskenazi (December 2010) 118:1768–1774.

Organophosphate (OP) pesticides are well-known neurotoxicants that have been associated with neurobehavioral deficits in children. Marks et al. evaluated attention-related outcomes among Mexican-American children participating in the CHAMACOS study (331 children 3.5 years and 323 children 5 years of age), and measured urinary dialkyl phosphate (DAP) metabolites in the children and in their mothers during pregnancy to determine OP exposure. The authors report that prenatal DAP levels were positively but not significantly associated with maternal reports of attention problems or attention deficit/hyperactivity disorder (ADHD) at 3.5 years, and were significantly associated with these outcomes at 5 years. Some associations appeared to be modified by sex, with associations found only among boys. There was also limited evidence of associations between the outcomes and DAP levels measured in the children. The authors conclude that *in utero* DAPs and, to a lesser extent, DAPs in children, were associated adversely with attention.

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M. Nathaniel Mead (December 2010) 118:A528–A534.



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John Manuel (October 2010) 118:A429.

EDITORIAL

Strength in Numbers: Three Separate Studies Link *in Utero* Organophosphate Pesticide Exposure and Cognitive Development

Kimberly Gray, Cindy P. Lawler (August) 119:A328–A329.

PODCAST | A RESEARCHER'S PERSPECTIVE

Communicating about Chemical Body Burden

with Tracey Woodruff and Rachel Morello-Frosch (1 May 2011)

PESTICIDES

Prenatal Organochlorine Compound Exposure, Rapid Weight Gain, and Overweight in Infancy

Michelle A. Mendez, Raquel Garcia-Esteban, Mónica Guxens, Martine Vrijheid, Manolis Kogevinas, Fernando Goñi, Silvia Fochs, Jordi Sunyer (February) 119:272–278.

Although it has been hypothesized that fetal exposure to endocrine-disrupting chemicals may increase risk for obesity, empirical data are limited. Mendez et al. explored whether prenatal exposure to several organochlorine compounds (OCs) is associated with rapid growth in the first 6 months of life and body mass index (BMI) later in infancy. Generalized linear models were used to estimate associations of rapid growth or elevated BMI with 2,2-bis(*p*-chlorophenyl)-1,1-dichloroethylene (DDE), hexachlorobenzene, β -hexachlorohexane, and polychlorinated biphenyls in first-trimester maternal serum. DDE exposure above the first quartile was positively associated with rapid growth among children of mothers of normal weight, but not among those of overweight mothers. DDE was also associated with elevated BMI at 14 months of age. Other OCs were not associated with rapid growth or elevated BMI. The authors conclude that prenatal DDE exposure appears to be associated with rapid weight gain in infants \leq 6 months of age and with elevated BMI in older infants of normal-weight mothers. More research exploring the potential role of chemical exposures in early-onset obesity seems warranted.

PESTICIDES

Acute Pesticide Illnesses Associated with Off-Target Pesticide Drift from Agricultural Applications: 11 States, 1998–2006

Soo-Jeong Lee, Louise Mehler, John Beckman, Brienne Diebolt-Brown, Joanne Prado, Michelle Lackovic, Justin Waltz, Prakash Mulay, Abby Schwartz, Yvette Mitchell, Stephanie Moraga-McHaley, Rita Gergely, Geoffrey M. Calvert (August) 119:1162–1169.

Pesticides are widely used in agriculture, and off-target pesticide drift (i.e., pesticide spray, volatiles, and contaminated dust) exposes workers and the public to harmful chemicals. Lee et al. used data for 1998–2006 obtained from the National Institute for Occupational Safety and Health's Sentinel Event Notification System for Occupational Risks (SENSOR)–Pesticides program and the California Department of Pesticide Regulation to estimate the incidence of acute illnesses resulting from pesticide drift from outdoor agricultural applications. They characterized acute illness cases by demographics, pesticide and application variables, health effects, and contributing factors and identified 2,945 cases associated with agricultural pesticide drift from 11 states. Common factors contributing to drift cases included weather conditions, improper seal of the fumigation site, and applicator carelessness near nontarget areas. Agricultural workers and residents (including children younger than 15 years of age) in agricultural regions had the highest rate of pesticide poisoning from drift exposure. Findings of this study highlight areas where interventions to reduce off-target drift could be focused.

PESTICIDES

Prenatal Exposure to Organophosphates, Paraoxonase 1, and Cognitive Development in Childhood

Stephanie M. Engel, James Wetmur, Jia Chen, Chenbo Zhu, Dana Boyd Barr, Richard L. Canfield, Mary S. Wolff (August) 119:1182–1188.

Prenatal exposure to organophosphate pesticides has been associated with alterations children's neurobehavioral development. Engel et al. evaluated 404 mother–infant pairs in the Mount Sinai Children's Environmental Health Cohort (multiethnic prenatal population in New York City enrolled between 1998 and 2002) to examine the relationship between biomarkers of organophosphate exposure; paraoxonase 1 (PON1), a key enzyme in the metabolism of organophosphates; and cognitive development in children. Third-trimester maternal urine samples were collected and analyzed for organophosphate metabolites, and prenatal maternal blood was analyzed for PON1 activity and genotype. Children returned for neurodevelopmental assessment at ages 12 months, 24 months, and 6–9 years. Prenatal total maternal dialkylphosphate metabolite level was associated with altered neurodevelopment at 12 months of age among black and Hispanic children; these associations appeared to be enhanced among children of mothers who carried the *PON1* Q192R QR/RR genotype. In later childhood, increasing prenatal total dialkyl- and dimethylphosphate metabolites were associated with decrements in perceptual reasoning in those with the maternal *PON1* Q192R QQ genotype. These findings suggest that prenatal exposure to organophosphates is negatively associated with cognitive development and that PON1 may be an important susceptibility factor for these effects.

PESTICIDES

Prenatal Exposure to Organophosphate Pesticides and IQ in 7-Year-Old Children

Maryse F. Bouchard, Jonathan Chevrier, Kim G. Harley, Katherine Kogut, Michelle Vedar, Norma Calderon, Celina Trujillo, Caroline Johnson, Asa Bradman, Dana Boyd Barr, Brenda Eskenazi (August) 119:1189–1195.

Organophosphate (OP) pesticides are neurotoxic at high doses, but few studies have examined whether chronic exposure at lower levels could adversely affect cognitive development in children. Bouchard et al. examined associations between prenatal and postnatal exposure to OP pesticides and cognitive abilities in school-age children participating in the Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) birth cohort study, which investigates pesticide and other environmental exposures and the health of pregnant women and their children living in an agricultural community. Exposure to OP pesticides was assessed by measuring dialkyl phosphate (DAP) metabolites in urine collected during pregnancy and from children at 6 months and 1, 2, 3.5, and 5 years of age. The Wechsler Intelligence Scale for Children was administered to children at 7 years of age. Mean maternal DAP concentrations were associated with poorer scores for Working Memory, Processing Speed, Verbal Comprehension, Perceptual Reasoning, and Full-Scale IQ. Children in the highest quintile of maternal DAP concentrations had an average deficit of 7.0 IQ points compared with those in the lowest quintile. However, children's urinary DAP concentrations were not consistently associated with changes in cognitive scores. The researchers conclude that prenatal, but not postnatal, urinary DAP concentrations were associated with poorer intellectual development in 7-year-old children. Maternal urinary DAP concentrations were high, but they were within the range of levels measured in the general U.S. population.

PESTICIDES

Seven-Year Neurodevelopmental Scores and Prenatal Exposure to Chlorpyrifos, a Common Agricultural Pesticide

Virginia Rauh, Srikesh Arunajadai, Megan Horton, Frederica Perera, Lori Hoepner, Dana B. Barr, Robin Whyatt (August) 119:1196–1201.

Prenatal exposure to chlorpyrifos (CPF) has been reported to be associated with neurodevelopmental problems in children at 3 years of age. To estimate the relationship between prenatal CPF exposure and neurodevelopment among children at 7 years of age, Rauh et al. measured CPF exposure in umbilical cord blood plasma from 265 children who were participants in the Columbia Center for Children's Environmental Health cohort. Neurodevelopment was assessed using the Wechsler Intelligence Scale for Children. On average, for each standard deviation increase in CPF exposure, Full-Scale IQ declined by 1.4% and Working Memory declined by 2.8%. The researchers found no significant interactions between CPF and any covariates (i.e., maternal educational level, maternal IQ, quality of the home environment), including other chemical exposures measured during the prenatal period (environmental tobacco smoke and polycyclic aromatic hydrocarbons). These findings are important in light of continued widespread use of CPF in agricultural settings and possible long-term effects of these exposures.

OTHER CHEMICALS/COMPOUNDS

(E.G., BPA, PCBS, PBDES, PFCS, PHTHALATES, ENDOCRINE DISRUPTORS)

Polybrominated Diphenyl Ether (PBDE) Flame Retardants and Thyroid Hormone during Pregnancy

Jonathan Chevrier, Kim G. Harley, Asa Bradman, Myriam Gharbi, Andreas Sjödén, Brenda Eskenazi (October 2010) 118:1444–1449.

Human exposure to polybrominated diphenylether (PBDE) flame retardants has increased significantly over the last three decades. Animal and human studies suggest that PBDEs may disrupt thyroid function; although thyroid hormone (TH) of maternal origin is essential to normal fetal brain development, human data regarding associations between exposure to PBDEs and maternal thyroid hormone levels during pregnancy are scarce. Chevrier et al. measured the concentration of 10 PBDE congeners, free thyroxine (T_4), total T_4 , and thyroid-stimulating hormone (TSH) in pregnant women around the 27th week of gestation. Serum concentrations of the individual PBDE congeners BDEs 28, 47, 99, 100, and 153 and their sum were inversely associated with TSH levels. Associations between PBDEs and free and total T_4 were not statistically significant. The authors conclude that exposure to PBDEs is associated with lower TSH during pregnancy, which may have implications for maternal health and fetal development.

NEWS | SCIENCE SELECTION

Thyroid Insult: Flame Retardants Linked to Alterations in Pregnant Women's TSH Levels

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PODCAST | A RESEARCHER'S PERSPECTIVE

The San Antonio Statement

with Åke Bergman (1 January 2011)

OTHER CHEMICALS/COMPOUNDS

(E.G., BPA, PCBS, PBDES, PFCS, PHTHALATES, ENDOCRINE DISRUPTORS)

Childhood Exposure to Phthalates: Associations with Thyroid Function, Insulin-like Growth Factor I, and Growth

Malene Boas, Hanne Frederiksen, Ulla Feldt-Rasmussen, Niels E. Skakkebaek, Laszlo Hegedüs, Linda Hilsted, Anders Juul, Katharina M. Main (October 2010) 118:1458–1464.

Humans are widely exposed to phthalates from a variety of sources. Although studies have suggested that phthalates have thyroid-disrupting properties, there is limited information with regard to children. Boas et al. measured urinary concentrations of 12 phthalate metabolites as well as serum levels of thyroid-stimulating hormone, thyroid hormones, and insulin growth factor-I (IGF-I) in children 4–9 years of age. Phthalate metabolites were detected in all urine samples, and monobutyl phthalate was present in the highest concentration. Phthalate metabolites were inversely associated with serum levels of free and total triiodothyronine, especially in girls, whereas metabolites of di(2-ethylhexyl) phthalate and diisononyl phthalate were inversely associated with IGF-I in boys. Most phthalate metabolites were negatively associated with height, weight, body surface, and height gain in both sexes. The authors conclude that urinary phthalate concentrations are inversely associated with thyroid hormones, IGF-I, and growth in children.

OTHER CHEMICALS/COMPOUNDS

(E.G., BPA, PCBS, PBDES, PFCS, PHTHALATES, ENDOCRINE DISRUPTORS)

Selecting Adequate Exposure Biomarkers of Diisononyl and Diisodecyl Phthalates: Data from the 2005–2006 National Health and Nutrition Examination Survey

Antonia M. Calafat, Lee-Yang Wong, Manori J. Silva, Ella Samandar, James L. Preau Jr., Lily T. Jia, Larry L. Needham (January) 119:50–55.

High molecular weight phthalates, such as diisononyl phthalate (DINP) and diisodecyl phthalate (DIDP), are used primarily as polyvinyl chloride plasticizers and may be present in many common products (e.g., flooring, wall coverings, building materials, heat-resistant electrical cords, car interiors, toys). Calafat et al. assessed exposure to DINP and DIDP in a representative sample of the U.S. general population ≥ 6 years of age using a subset of the 2005–2006 National Health and Nutrition Examination Survey (NHANES). The authors detected monocarboxyisooctyl phthalate (MCOP), a metabolite of DINP, and monocarboxyisononyl phthalate (MCNP), a metabolite of DIDP, in 95.2% and 89.9% of the urine samples, respectively. They also detected monoisononyl phthalate (MNP), a minor metabolite of DINP, much less frequently and at concentrations much lower than those of MCOP. Mean concentrations of MCOP and MCNP were significantly higher among children than among adolescents and adults. The authors conclude that the general U.S. population, including children, has been exposed to DINP and DIDP. In previous NHANES cycles, the occurrence of human exposure to DINP using MNP as the sole urinary biomarker may have been underestimated. These findings underscore the importance of selecting the most adequate biomarkers for exposure assessment.

OTHER CHEMICALS/COMPOUNDS

(E.G., BPA, PCBS, PBDES, PFCS, PHTHALATES, ENDOCRINE DISRUPTORS)

Variability and Predictors of Urinary Bisphenol A Concentrations during Pregnancy

Joe M. Braun, Amy E. Kalkbrenner, Antonia M. Calafat, John T. Bernert, Xiaoyun Ye, Manori J. Silva, Dana Boyd Barr, Sheela Sathyanarayana, Bruce P. Lanphear (January) 119:131–137.

Prenatal exposure to bisphenol A (BPA) may be associated with developmental toxicity, but few studies have examined the variability and predictors of urinary BPA concentrations during pregnancy. Braun et al. measured BPA concentrations during pregnancy and at birth in three spot urine samples. They report that of the occupations studied, cashiers had the highest BPA concentrations. Consuming canned vegetables at least once a day was associated with higher BPA concentrations compared with those consuming no canned vegetables. BPA concentrations did not vary by consumption of fresh fruits and vegetables, canned fruit, or store-bought fresh and frozen fish. Concentrations of urinary high-molecular-weight phthalate and serum tobacco smoke metabolites were positively associated with BPA concentrations. According to the authors, these results suggest numerous sources of BPA exposure during pregnancy. Etiological studies may need to measure urinary BPA concentrations more than once during pregnancy and adjust for phthalates and tobacco smoke exposures.

OTHER CHEMICALS/COMPOUNDS

(E.G., BPA, PCBS, PBDES, PFCS, PHTHALATES, ENDOCRINE DISRUPTORS)

Environmental Chemicals in Pregnant Women in the United States: NHANES 2003–2004

Tracey J. Woodruff, Ami R. Zota, Jackie M. Schwartz (June) 119:878–885.

Woodruff et al. analyzed biomonitoring data from the National Health and Nutrition Examination Survey (NHANES) to characterize both individual and multiple chemical exposures in pregnant women in the United States. They analyzed data for 163 chemical analytes in 12 chemical classes for subsamples of 268 pregnant women from NHANES 2003–2004. The percentage of pregnant women with detectable levels of an individual chemical ranged from 0 to 100%. Certain polychlorinated biphenyls, organochlorine pesticides, perfluorinated compounds (PFCs), phenols, polybrominated diphenyl ethers, phthalates, polycyclic aromatic hydrocarbons, and perchlorate were detected in 99–100% of pregnant women. The median number of detected chemicals by chemical class ranged from 4 of 12 PFCs to 9 of 13 phthalates. Across chemical groups, the median number ranged from 8 of 17 chemical analytes to 50 of 71 chemical analytes. Levels in pregnant women were similar to or lower than levels in nonpregnant women. Further efforts are warranted to understand sources of exposure in pregnant women and implications for policy making.

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Chemical Count: Quantifying Exposures in Pregnant Women

OTHER CHEMICALS/COMPOUNDS

(E.G., BPA, PCBS, PBDES, PFCS, PHTHALATES, ENDOCRINE DISRUPTORS)

Food Packaging and Bisphenol A and Bis(2-Ethylhexyl) Phthalate Exposure: Findings from a Dietary Intervention

Ruthann A. Rudel, Janet M. Gray, Connie L. Engel, Teresa W. Rawsthorne, Robin E. Dodson, Janet M. Ackerman, Jeanne Rizzo, Janet L. Nudelman, Julia Green Brody (July) 119:914–920.

Bisphenol A (BPA) and bis(2-ethylhexyl) phthalate (DEHP) are high-production, high-volume chemicals used in plastics and resins for food packaging. Human exposure sources have been estimated, but the relative contribution of dietary exposure to total intake has not been studied empirically. Rudel et al. evaluated the contribution of food packaging as a means of exposure by measuring urinary BPA and phthalate metabolites before, during, and after a “fresh foods” dietary intervention. Participants in the study ate their usual diet, followed by 3 days of “fresh foods” that were not canned or packaged in plastic, and then returned to their usual diet. Evening urine samples were collected over 8 days and were categorized as preintervention, during intervention, and postintervention samples. BPA and DEHP exposures were substantially reduced when participants’ diets were restricted to food with limited packaging. Results of this study suggest that removing BPA and DEHP from food packaging could significantly decrease exposure to these chemicals.

NEWS | SCIENCE SELECTION

Plastics and Food Sources: Dietary Intervention to Reduce BPA and DEHP

OTHER CHEMICALS/COMPOUNDS

(E.G., BPA, PCBS, PBDES, PFCS, PHTHALATES, ENDOCRINE DISRUPTORS)

Case Report: High Prenatal Bisphenol A Exposure and Infant Neonatal Neurobehavior

Sheela Sathyanarayana, Joe M. Braun, Kimberly Yolton, Stacey Liddy, Bruce P. Lanphear (August) 119:1170–1175.

Animal studies and one human study suggest that bisphenol A (BPA) may be neurotoxic. Sathyanarayana et al. report that a mother in the Health Outcomes and Measures of the Environment (HOME) Study had a urinary BPA concentration at 27 weeks of pregnancy, which was the highest concentration observed in the cohort. The authors used prenatal questionnaire data and a follow-up interview to identify potential sources of exposure including daily use of plastic and consumption of canned beverages and foods. The woman’s male infant had a normal newborn neurobehavioral assessment but at the 1-month exam presented with abnormalities that prompted physician referral. The child had normal results on neurobehavioral tests at annual evaluations at 1–5 years of age. This case highlights a potential link between gestational BPA exposure and transient neurobehavioral changes. The authors conclude that health care practitioners should be educated regarding potential sources of BPA exposure and guidance to minimize exposures to endocrine-disrupting chemicals during vulnerable periods of development.

OTHER CHEMICALS/COMPOUNDS

(E.G., BPA, PCBS, PBDES, PFCS, PHTHALATES, ENDOCRINE DISRUPTORS)

Polycyclic Aromatic Hydrocarbons–Aromatic DNA Adducts in Cord Blood and Behavior Scores in New York City Children

Frederica P. Perera, Shuang Wang, Julia Vishnevetsky, Bingzhi Zhang, Kathleen J. Cole, Deliang Tang, Virginia Rauh, David H. Phillips (August) 119:1176–1181.

Airborne polycyclic aromatic hydrocarbons (PAHs) are widespread urban pollutants that can bind to DNA to form PAH–DNA adducts. Prenatal PAH exposure measured by personal monitoring has been linked to cognitive deficits in childhood in a prospective study conducted by the Columbia Center for Children’s Environmental Health. Following 215 children born to nonsmoking African-American and Dominican women residing in New York City, Perera et al. measured PAH–DNA adducts and other bulky aromatic adducts in umbilical cord white blood cells to determine the association between this molecular dosimeter and behavioral/attention problems in childhood, with child behavior assessed using the Child Behavior Checklist. Higher cord adducts were associated with higher symptom scores for anxious/depressed at 4.8 years of age, attention problems at 4.8 and 7 years, and anxiety problems at 4.8 years. These results suggest that PAH exposure, as reflected by the presence of DNA adducts, may be associated with alterations in child behavior, potentially affecting school performance.

OTHER CHEMICALS/COMPOUNDS

(E.G., BPA, PCBS, PBDES, PFCS, PHTHALATES, ENDOCRINE DISRUPTORS)

Dioxin Exposure and Age of Pubertal Onset among Russian Boys

Susan A. Korrick, Mary M. Lee, Paige L. Williams, Oleg Sergeev, Jane S. Burns, Donald G. Patterson Jr, Wayman E. Turner, Larry L. Needham, Larisa Altshul, Boris Revich, Russ Hauser (September) 119:1339–1344.

Research in animals has linked exposure to dioxins, furans, and polychlorinated biphenyls (PCB) with altered male gonadal maturation, but it is unclear whether these associations apply to human populations. Korrick et al. studied pubertal onset in boys 8–9 years of age from a dioxin-contaminated region of Russia. Serum collected at enrollment was analyzed for concentrations of dioxins, furans, and PCBs. Total serum toxicity equivalent quotients (TEQs) were approximately three times higher than those found in European children. Higher dioxin TEQs were associated with later pubertal onset as indicated by testicular volume. Similar associations were observed for 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) and dioxin concentrations. These findings support an association of higher peripubertal serum dioxin TEQs and concentrations with later male pubertal onset reflected in delayed testicular maturation.

AIR POLLUTION: PARTICULATE MATTER/SMOKE/INDOOR AIR

From Good Intentions to Proven Interventions: Effectiveness of Actions to Reduce the Health Impacts of Air Pollution

Luisa V. Giles, Prabjit Barn, Nino Künzli, Isabelle Romieu, Murray A. Mittleman, Stephan van Eeden, Ryan Allen, Chris Carlsten, Dave Stieb, Curtis Noonan, Audrey Smargiassi, Joel D. Kaufman, Shakoor Hajat, Tom Kosatsky, Michael Brauer (January) 119:29–36.

Associations between air pollution and a multitude of health effects are now well established. Given widespread exposure to air pollution, the attributable health burden can be high, particularly for susceptible populations. Giles et al. describe the findings of an international multidisciplinary workshop convened to discuss current knowledge regarding air pollution exposure and health impacts relevant to public health recommendations. During the workshop, experts reviewed the biological mechanisms of action of air pollutants in the initiation and progression of disease, as well as the state of the science regarding community and individual-level interventions. The workshop highlighted strategies to reduce individual risk of conditions associated with increased susceptibility to the effects of air pollution and the need to better understand the role of exposure duration in disease progression, reversal, and adaptation. Two promising and largely unexplored strategies to address and mitigate air pollution-related health impacts were identified: reducing individual baseline risk of cardiovascular disease and incorporating air pollution-related health impacts into land-use decisions.

NEWS | SCIENCE SELECTION

Separating People from Pollution: Individual and Community Interventions to Mitigate Health Effects of Air Pollutants

AIR POLLUTION: PARTICULATE MATTER/SMOKE/INDOOR AIR

Particulate Matter–Induced Health Effects: Who Is Susceptible?

Jason D. Sacks, Lindsay Wichers Stanek, Thomas J. Luben, Douglas O. Johns, Barbara J. Buckley, James S. Brown, Mary Ross (April) 119:446–454.

Sacks et al. evaluated the epidemiological and toxicological literature to identify those populations potentially at greatest risk of health effects associated with exposure to particulate matter (PM). They also formulated a definition of susceptibility based on information available in the current literature. On the basis of their review, the authors identified a number of characteristics that are associated with increased risk of PM-related health effects, including life stage (i.e., children and older adults), preexisting cardiovascular or respiratory diseases, genetic polymorphisms, and low socioeconomic status. In addition, they developed a comprehensive definition of susceptibility that encompasses all populations potentially at increased risk of adverse health effects as a consequence of exposure to air pollution.

NEWS | SCIENCE SELECTION

Who's at Risk? Gauging Susceptibility to Air Pollutants

AIR POLLUTION: PARTICULATE MATTER/SMOKE/INDOOR AIR

Survival Analysis of Long-Term Exposure to Different Sizes of Airborne Particulate Matter and Risk of Infant Mortality Using a Birth Cohort in Seoul, Korea

Ji-Young Son, Michelle L. Bell, Jong-Tae Lee (May) 119:725–730.

Although several studies have suggested that airborne particulate matter (PM) is associated with infant mortality, most research has focused on short-term exposure to larger particles. Son et al. evaluated associations between long-term exposure to different sizes of particles [total suspended particles (TSP), $PM \leq 10 \mu m$ in aerodynamic diameter (PM_{10}), ≤ 10 to $2.5 \mu m$ ($PM_{10-2.5}$), and $\leq 2.5 \mu m$ ($PM_{2.5}$)] and infant mortality. There was a positive relationship between gestational exposures to PM and infant mortality from all causes or respiratory causes for normal-birth-weight infants. These findings support the hypothesis that long-term exposure to PM air pollution during pregnancy increases risk of infant mortality.

AIR POLLUTION: PARTICULATE MATTER/SMOKE/INDOOR AIR

Ambient Air Pollution and Birth Weight in Full-Term Infants in Atlanta, 1994–2004

Lyndsey A. Darrow, Mitchel Klein, Matthew J. Strickland, James A. Mulholland, Paige E. Tolbert (May) 119:731–737.

Darrow et al. examined relationships between birth weight and temporal variation in ambient levels of carbon monoxide, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone, particulate matter ($PM \leq 10 \mu m$ in aerodynamic diameter, $PM \leq 2.5 \mu m$ ($PM_{2.5}$), $PM 2.5-10 \mu m$, and measures of the chemical components of $PM_{2.5}$. Ambient levels of NO_2 , SO_2 , $PM_{2.5}$ elemental carbon, and $PM_{2.5}$ water-soluble metals during the third trimester were significantly associated with small reductions in birth weight. Third-trimester estimates were generally higher in Hispanic and non-Hispanic black infants relative to non-Hispanic white infants. The results also suggested an association between air pollutant concentrations in late pregnancy and reduced birth weight. These results provide support for an association between exposure to ambient air pollution in late pregnancy and decreased birth weight in full-term infants.

AIR POLLUTION: PARTICULATE MATTER/SMOKE/INDOOR AIR

Estimating the Global Public Health Implications of Electricity and Coal Consumption

Julia M. Gohlke, Reuben Thomas, Alistair Woodward, Diarmid Campbell-Lendrum, Annette Prüss-Üstün, Simon Hales, Christopher J. Portier (June) 119:821–826.

The growing health risks associated with greenhouse gas emissions highlight the need for new energy policies emphasizing efficiency and low-carbon energy intensity. Gohlke et al. assessed the relationships among electricity use, coal consumption, and health outcomes. Using time-series data sets from 41 countries with varying development trajectories over a 40-year period, they developed an autoregressive model of life expectancy (LE) and infant mortality (IM) based on electricity consumption, coal consumption, and previous year's LE or IM. Prediction of health impacts from an integrated air pollution emissions health impact model (GAINS; Greenhouse Gas and Air Pollution Interactions and Synergies) for coal-fired power plants was compared to the time-series model results. The time-series model predicted that increased electricity consumption is associated with reduced IM for countries with relatively high IM and low LE at the start of the study, whereas LE was not significantly associated with electricity consumption regardless of IM and LE. Increasing coal consumption was associated with increased IM and reduced LE after accounting for electricity consumption. These results are consistent with results based on the GAINS model and previously published estimates of disease burdens attributable to energy-related environmental factors including indoor and outdoor air pollution and water and sanitation. Findings suggest that increased electricity consumption in countries with IM < 100 per 1,000 live births does not lead to greater health benefits, whereas coal consumption has significant detrimental health impacts.

NEWS | SCIENCE SELECTION

Public Health Impact of Coal and Electricity Consumption: Risk–Benefit Balance Varies by Country

AIR POLLUTION: PARTICULATE MATTER/SMOKE/INDOOR AIR

Does Air Pollution Trigger Infant Mortality in Western Europe? A Case-Crossover Study

Hans Scheers, Samuel M. Mwalili, Christel Faes, Frans Fierens, Benoit Nemery, Tim S. Nawrot (July) 119:1017–1022.

Many studies have reported associations between fine particulate air pollutants [particulate matter $\leq 10 \mu\text{m}$ in aerodynamic diameter (PM_{10})] and mortality in adults. Scheers et al. investigated short-term effects of elevated PM_{10} levels on infant mortality in Flanders, Belgium, and studied whether the European Union limit value protects infants from the air pollution trigger. They estimated the risk of dying from nontraumatic causes before 1 year of age in relation to outdoor PM_{10} concentrations on the day of death, and they matched control days on temperature to exclude confounding by variations in daily temperature. Even in an affluent region in Western Europe, where infant mortality is low, days with higher PM air pollution are associated with an increased risk of infant mortality. Assuming causality, the current European Union limit value for PM_{10} , which may be exceeded on 35 days/year, does not appear to prevent PM_{10} from triggering mortality in late neonates.

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Nuntavarn Vichit-Vadakan and Nitaya Vajanapoom (May) 119:A197–A198.

AIR POLLUTION: PARTICULATE MATTER/SMOKE/INDOOR AIR

Thirdhand Tobacco Smoke: Emerging Evidence and Arguments for a Multidisciplinary Research Agenda

Georg E. Matt, Penelope J. E. Quintana, Hugo Destailats, Lara A. Gundel, Mohamad Sleiman, Brett C. Singer, Peyton Jacob III, Neal Benowitz, Jonathan P. Winickoff, Virender Rehan, Prue Talbot, Suzaynn Schick, Jonathan Samet, Yinsheng Wang, Bo Hang, Manuela Martins-Green, James F. Pankow, Melbourne F. Hovell (September) 119:1218–1226.

Although there is broad consensus regarding the health impact of the use of tobacco and secondhand smoke exposure, there is considerable uncertainty about the consequences of exposure to thirdhand smoke (THS), also known as residual or aged tobacco smoke. Matt et al. report that physical and chemical transformations of tobacco smoke pollutants create toxic secondary pollutants. THS persists in real-world residential settings in the air, dust, and surfaces, and is associated with elevated levels of nicotine on hands and cotinine in the urine of nonsmokers. Existing health information on THS supports the need for additional research to close gaps in understanding the chemistry, exposure, toxicology, health effects, and policy implications of THS. Research in this area will help illuminate the role of THS in existing and future efforts to decrease initiation and levels of smoking, facilitate cessation efforts, and reduce the cumulative effects of tobacco use on morbidity and mortality.

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Thirdhand Smoke in Review: Research Needs and Recommendations

AIR POLLUTION: PARTICULATE MATTER/SMOKE/INDOOR AIR

Three Measures of Forest Fire Smoke Exposure and Their Associations with Respiratory and Cardiovascular Health Outcomes in a Population-Based Cohort

Sarah B. Henderson, Michael Brauer, Ying C. MacNab, Susan M. Kennedy (September) 119:1266–1271.

Henderson et al. studied the association between respiratory and cardiovascular symptoms and measures of smoke exposure following numerous fires in British Columbia, Canada, during the summer of 2003. Spatially specific daily exposure estimates were assigned to each subject in a population-based cohort using total PM₁₀ (particulate matter ≤ 10 μm in aerodynamic diameter) measurements from six regulatory air quality monitors, smoke-related PM₁₀ from a dispersion model, and plumes visible in satellite images. Correlations between air quality monitors, metrics from the dispersion model, and visible plumes were moderate. The results indicate an association between exposure to fire smoke and physician visits for respiratory, but not cardiovascular, outcomes, consistent with other studies. The agreement between air quality monitors and the other metrics suggests that exposure assessment tools that are independent of air quality monitoring may be useful with further refinement.

AIR POLLUTION: PARTICULATE MATTER/SMOKE/INDOOR AIR

Ambient Air Pollution and Apnea and Bradycardia in High-Risk Infants on Home Monitors

Jennifer L. Peel, Mitchel Klein, W. Dana Flanders, James A. Mulholland, Gary Freed, Paige E. Tolbert (September) 119:1321–1327.

Previous research has indicated that increased ambient air pollution concentrations are associated with health effects, although relatively few studies have specifically examined infants. Peel et al. studied associations of daily ambient air pollution concentrations with central apnea and bradycardia events among infants prescribed home cardiorespiratory monitors. The authors report associations between bradycardia and 8-hr maximum ozone and 1-hr maximum nitrogen dioxide. The association with ozone was robust to different methods of control for time trend and specified correlation structure. In secondary analyses, associations of apnea and bradycardia with pollution were generally stronger in infants who were full term and of normal birth weight than in infants who were both premature and low birth weight. These results suggest that higher air pollution concentrations may increase the occurrence of apnea and bradycardia in high-risk infants.

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Ambient Air Pollution and Infant Health: Home Monitors Make Cardiorespiratory Connections

AIR POLLUTION: PARTICULATE MATTER/SMOKE/INDOOR AIR

Residential Exposure to Outdoor Air Pollution during Pregnancy and Anthropometric Measures at Birth in a Multicenter Cohort in Spain

Marisa Estarlich, Ferran Ballester, Inmaculada Aguilera, Ana Fernández-Somoano, Aitana Lertxundi, Sabrina Llop, Carmen Freire, Adonina Tardón, Mikel Basterrechea, Jordi Sunyer, Carmen Iñiguez (September) 119:1333–1338.

A growing body of research suggests that prenatal exposure to air pollution may be harmful to fetal development. Estarlich et al. studied the association between exposure to air pollution during pregnancy and anthropometric measures at birth. They estimated exposure to ambient nitrogen dioxide (NO₂) and benzene for the residence of each woman for each trimester and for the entire pregnancy. Outcomes included birth weight, length, and head circumference of the infant. An increase in NO₂ exposure during pregnancy was associated with a decrease in birth length. For the subset of women who spent ≥ 15 hr/day at home, the association was stronger. For this same subset of women, a reduction in birth weight was associated with an increase in NO₂ exposure in the second trimester. The researchers did not observe a significant relationship between benzene levels and birth outcomes. These results underscore concerns that exposure to air pollution during pregnancy is associated with altered fetal development.

ENDOTOXINS AND WATER TOXINS

Temporal and Spatial Patterns of Ambient Endotoxin Concentrations in Fresno, California

Ira B. Tager, Frederick W. Lurmann, Thaddeus Haight, Siana Alcorn, Bryan Penfold, S. Katharine Hammond (October 2010) 118:1490–1496.

Endotoxins are found in indoor dust generated by human activity and pets and are adsorbed onto the surfaces of ambient combustion particles. Endotoxin concentrations have been associated with respiratory symptoms and the risk of atopy and asthma. Tager et al. measured ambient concentrations of endotoxin and air pollutants at the California Air Resources Board's central ambient monitoring site in Fresno, California, and—for short periods—at 10 schools and both indoors and outdoors at 84 residences in the community. Analyses were restricted to dry months when endotoxin concentrations are highest. The authors report that endotoxin levels were generally lowest in areas distant from agricultural activities, and the highest concentrations were found in areas immediately downwind from agricultural/pasture land. Among three other measured air pollutants—fine particulate matter, elemental carbon, and coarse particulate matter—only coarse particulate matter was correlated with endotoxin; however, endotoxin was the most spatially variable. The authors conclude that studies of exposure and health effects should evaluate the spatial/temporal variability of endotoxin concentrations, rather than relying on a few measurements made at one location.

CLIMATE CHANGE

Global Climate Change and Children's Health: Threats and Strategies for Prevention

Perry E. Sheffield, Philip J. Landrigan (March) 119:291–298.

Global climate change has been proposed to have multiple effects on human health, and vulnerable populations such as children, the elderly, and the poor may be disproportionately affected. Sheffield et al. suggest that climate change could increase the global burden of disease by changing the range of vector-borne diseases such as malaria and dengue, increasing diarrheal and respiratory disease, increasing morbidity and mortality from extreme weather, changing exposures to toxic chemicals, exacerbating poverty, increasing food and physical insecurity, and threatening human habitation. They also note that there is increasing evidence for climate change-related decreases in school performance and increased rates of pregnancy complications. Health effects associated with climate change appear to differ by geographic region and socioeconomic status. According to the authors, prevention strategies to reduce potential health impacts of climate change include reduction of greenhouse gas emissions and adaptation through multiple public health interventions. Quantification of the effects of climate change on children's health is needed at the global, regional, and local levels.

NEWS | SCIENCE SELECTION

Climate Change and Children's Health: Protecting and Preparing Our Youngest

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CLIMATE CHANGE

Uncertainties Associated with Quantifying Climate Change Impacts on Human Health: A Case Study for Diarrhea

Erik W. Kolstad, Kjell Arne Johansson (March) 119:299–305.

Many scientists believe that climate change could have a large impact on the health of people living at lower latitudes, areas where droughts and malnutrition, diarrhea, and malaria are projected to increase. Kolstad and Johansson describe a method to assess a range of potential health impacts of climate change while controlling for uncertainties in a transparent manner. As a case study, the authors computed projected increases in diarrhea based on data from empirical studies and a climate model for six geographical regions. For a projected increase in temperature of up to 4°C over land in the tropics and subtropics by the end of this century, they projected increases of relative risk of diarrhea of 8–11% for 2010–2039 and 22–29% for 2070–2099. Although the model supports the possibility of substantial effects of climate change on the incidence of diarrhea, the authors note that there are large uncertainties associated with these projections, in part because of the paucity of empirical data related to climate effects on human health.

CLIMATE CHANGE

Impacts of Climate Change on Public Health in India: Future Research Directions

Kathleen F. Bush, George Luber, S. Rani Kotha, R.S. Dhaliwal, Vikas Kapil, Mercedes Pascual, Daniel G. Brown, Howard Frumkin, R.C. Dhiman, Jeremy Hess, Mark L. Wilson, Kalpana Balakrishnan, Joseph Eisenberg, Tanvir Kaur, Richard Rood, Stuart Batterman, Aley Joseph, Carina J. Gronlund, Arun Agrawal, Howard Hu (June) 119:765–770.

It has been proposed that increases in climate variability may further exacerbate global health disparities, especially in developing countries such as India. Bush et al. reviewed the literature and discussed priorities and strategies for future research on the consequences of climate change in India. The authors conclude that it will be important to improve the surveillance, monitoring, and integration of meteorological, environmental, geospatial, and health data while working in parallel to implement adaptation strategies. India will also need to improve information infrastructure and promote interdisciplinary collaborations. This will require coordinated levels of collaboration across diverse institutions in India and elsewhere. The resulting information can be used in research on the likely impacts of climate change on health that reflect India's diverse climates and populations.

CLIMATE CHANGE

Drinking Water Salinity and Maternal Health in Coastal Bangladesh: Implications of Climate Change

Aneire Ehmar Khan, Andrew Ireson, Sari Kovats, Sontosh Kumar Mojumder, Amirul Khusru, Atiq Rahman, Paolo Vineis (September) 119:1328–1332.

Drinking water from natural sources in coastal Bangladesh has become contaminated by salinity due to saltwater intrusion from rising sea levels, cyclone and storm surges, and upstream withdrawal of freshwater. Khan et al. estimated salt intake from drinking water sources and examined environmental factors that may explain a seasonal excess of hypertension in pregnancy. The average estimated sodium intake from drinking water in the dry season was about 10 times higher than that in the rainy season. Women who obtained water from shallow tube wells were more likely to have elevated sodium in the urine than women who drank rainwater. The annual hospital prevalence of hypertension in pregnancy was higher in the dry season than in the rainy season. The problem of saline intrusion into drinking water has multiple environmental causes and may be exacerbated by future changes in sea level. The results of this study should help inform public health decisions aimed at mitigating the potential health effects of climate change.

FOOD SAFETY/NUTRITION

Substance Flow Analysis: A Case Study of Fluoride Exposure through Food and Beverages in Young Children Living in Ethiopia

Marian Kjellevold Malde, Ruth Scheidegger, Kåre Julshamn, Hans-Peter Bader (April) 119:579–584.

Excessive dietary intake of fluoride continues to be a human health risk, particularly for vulnerable populations such as children in low-income countries where low-cost defluoridation methods are not available. To develop appropriate public health responses to this problem, it is necessary to understand the various sources for fluoride exposure in the environment. Malde et al. simulated the fluoride intake of the children using the methods of material flow analysis (MFA) and then quantified the potential reduction in total fluoride intake given different scenarios. The results show that both prepared food and food ingredients must be taken into consideration when assessing the total fluoride intake by children living in high-fluoride areas. The findings from this study will help public health officials give scientifically based advice on strategies for reducing the total fluoride intake by children living in areas where the potential to be exposed to fluoride is high.

METHODOLOGIES

Statistical Methods to Study Timing of Vulnerability with Sparsely Sampled Data on Environmental Toxicants

Brisa Ney Sánchez, Howard Hu, Heather J. Litman, Martha Maria Téllez-Rojo
(March) 119:409–415.

Identifying windows of vulnerability to environmental toxicants is an important area in children's health research. Sánchez et al. compared and contrasted statistical approaches that may help identify windows of vulnerability by formally testing differences in exposure effects across time windows of exposure, incorporating continuous time metrics for timing of exposure, and efficiently incorporating incomplete cases. The authors compared the use of window-specific and simultaneously adjusted regression, multiple informant models, models that use features of individual exposure patterns to predict outcomes, and models of population exposure patterns depending on the outcome using data from a study of prenatal vulnerability to lead in relation to Bayley's Mental Development Index at 24 months of age. The authors preferred a multiple information model over window-specific regression because it enables formal testing of differences in effects across *a priori*-defined windows (e.g., trimesters of pregnancy). They preferred the latter two models over the multiple informant model when there was large variability in the timing of exposure assessments among participants. The authors believe that these principles can be used in the design of studies in which windows of vulnerability may be critical.

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