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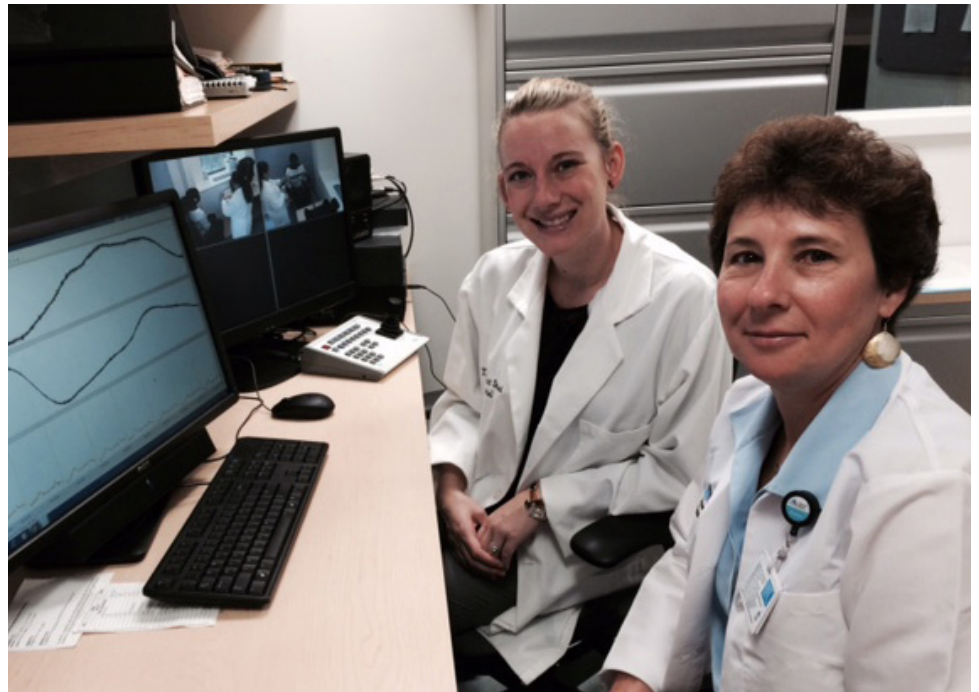
Institute for
Exposomic Research



Exposomics Review Spring 2019

Study: A Mother's Traumatic Life Experiences and Stress May Lead to Underweight Baby

A mother's traumatic life experiences and stress during pregnancy may cause her baby to be born underweight, according to a major study published in September 2018 in *The*



Kelly Brunst, PhD (left) and Rosalind Wright, MD, MPH. Dr. Brunst was one of the researchers involved in the study.

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Journal of Pediatrics and led by Rosalind J. Wright, MD, MPH, Dean of Translational Biomedical Research at the Icahn School of Medicine at Mount Sinai and Co-Director of the Institute for Exposomic Research.

Mothers who had been exposed to trauma at some point in their lives, even going back to their own childhood, and who secreted high levels of cortisol in late pregnancy, gave birth to male infants born 1.3 ounces smaller than average, Dr. Wright and her researchers from the Icahn School

of Medicine and other institutions found. The observed effects on lower birth weight for children born to women secreting the highest levels of cortisol (at or above the 90th percentile) were similar to other prenatal toxins such as smoking.

The consequential findings are the latest among dozens of studies published by Dr. Wright, a pioneer in the growing field of the science of resilience.

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Over nearly two decades, Dr. Wright, who is also Horace W. Goldsmith Professor of Pediatrics, and her team have detailed how harmful environmental factors that often disproportionately occur among lower-income populations can lead to higher risk for negative health outcomes such as obesity, diabetes, hypertension, and asthma. Those negative environmental triggers commonly found in low-income, ethnically mixed neighborhoods include toxins, such as air pollution and mold, as well as psychosocial factors such as increased experienced stress related to worry over finances or gun violence.

“We’re more focused on solution-oriented research. We really want to turn it the other way, not just to decrease exposures we know can be toxic, but to identify what other things we can do in the meantime to build resilience that can protect us from harm.”
says Rosalind J. Wright, MD, PhD

But remarkably, Dr. Wright has also found that protective factors, such as an antioxidant-rich diet and sensitive caregiving of babies, can mitigate exposure to harmful environmental and psychosocial factors, even among those who are particularly burdened by such toxins. Dr. Wright established a mother-child cohort in Boston in 2002 that she and her team still follow, as well as a New York City cohort that she began to follow in 2013.

“We never wanted to be all about identifying the risk factors,” Dr. Wright says. “We’re more focused on solution-oriented research. We really want to turn it the other way, not just to decrease exposures we know can be toxic, but to identify what other things we can do in the meantime to build resilience that can protect us from harm.”

Dr. Wright is currently leading a study designed to discover whether enhanced social support during pregnancy can help buffer a mother’s fetus from damage caused as a result of the mother’s experience of a traumatic event, such as domestic violence.

As part of her efforts to deepen our understanding of psychosocial

mechanisms in particular and how they impact human biology, Dr. Wright has collaborated with a number of child psychologists and engineers to establish a laboratory to identify the resiliency factors that help children stay on a healthy trajectory.

Dr. Wright has begun scaling up her solution-oriented research over the past two years, in part through a federally funded program known as Environmental Influences on Child Health Outcomes (ECHO), by establishing research protocols which are being adopted by researchers

around the country. “The power of such a study is in the numbers,” says Dr. Wright, “as participation in the national ECHO study will provide access to up to 50,000 potential mothers and children, which will allow us to examine many of these factors at the same time.”

Ultimately, Dr. Wright aims to pinpoint the earliest possible windows to intervene in a child’s life to build resilience and send the child on a healthier life trajectory. Those critical windows are often *in utero*, she has found.

Dr. Wright believes her findings into the science of resilience will help arm policymakers with solid data to bring research conclusions into action to directly improve children’s lifelong health.

A mother living in a poor neighborhood filled with pollution from a nearby highway can be advised to move elsewhere to protect her baby from the pollution, for example. But often, she can’t. She doesn’t have the financial means or social support to move to a healthier location.

“While we work to find solutions to these larger social barriers, we can provide these women and young families with information and tools that can buffer the effects of such

toxins, whether it is providing a healthy diet, strengthening social supports, or guidance on sensitive caregiving, all can be helpful in this situation,” she says. “Our aim is to help children and families thrive.”

Dr. Wright discusses the roots of her life’s work in a podcast released in January as part of Mount Sinai’s monthly series, *Road To Resilience*, based on the book *Resilience: The Science of Mastering Life’s Greatest Challenges*, co-authored by Dennis S. Charney, MD, Anne and Joel Ehrenkranz Dean of the Icahn School of Medicine at Mount Sinai, and Steven Southwick, MD, Professor of Psychiatry at Yale University.

Dr. Wright recounts how losing her brother to gun violence more than two decades ago in the rural town where she grew up caused her to shift her research focus from genetics to public health when completing her residency training in medicine.

“It’s been a very fascinating career path that I never would have had the courage to take if it hadn’t been for this tremendous loss,” Dr. Wright says in the podcast, titled “Thriving After a Devastating Loss.” She describes using active coping skills after her brother’s death to help protect her own health against the negative biological effects of grief.

“I think some of the major breakthroughs will be along the lines of how our psychological and emotional response to our environment gets embedded in the body and causes problems but also causes well-being. Identifying the biological signatures or markers of early resilience will help us intervene early to help children develop more optimally. Moreover, intervening similarly for women of childbearing age may be the best way to protect their children. I believe that this line of research—more than anything else I have been involved with in my career in medicine—is going to finally have great impact on reducing the growth in chronic diseases that we’re seeing.”

New Wearable Technologies Could Revolutionize Data Collection

Two novel sample collection methods, silicone wristbands and needle patches, have the potential to revolutionize the fields of precision medicine and environmental health by reducing the cost and time required to collect individual environmental exposure data. These two wearable technologies provide new capabilities to capture more refined measures of the external and internal exposome in large populations.

Douglas Walker, PhD, Assistant Professor of Environmental Medicine and Public Health at the Icahn School of Medicine at Mount Sinai, has found that applying untargeted screening methods that use high-resolution mass spectrometry to characterize the same type of silicone bracelets used by charities as a marketing tool has the potential to measure tens of thousands of compounds that represent environmental exposures. Dr. Walker's discovery builds upon initial research from Oregon State University that found that silicone wristbands can absorb environmental chemicals and are useful as low-cost, passive exposure monitors.

In an initial pilot study, Dr. Walker and collaborators at the Emory University HERCULES Exposome Center placed 10-cent silicone wristbands in different rooms in several houses over a period of seven days. They found that the wristbands revealed room-specific chemical signatures, suggesting that silicone is sensitive enough to precisely measure micro-environment exposures.

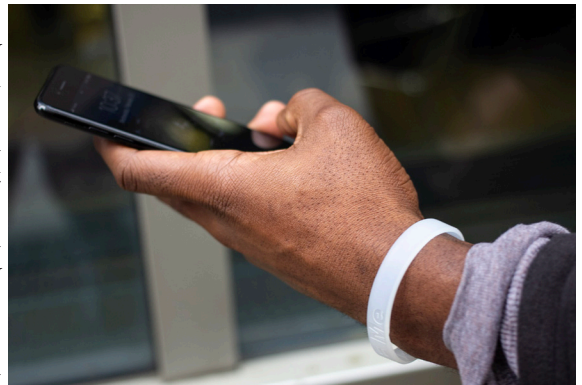
Dr. Walker and a team at Emory University are now analyzing results in a second study in which a small number of participants who suffer from multiple chemical sensitivity (MCS) wore the wristbands in order to identify triggers resulting in MCS symptoms. The wristbands can detect roughly 2,000 to 3,000 chemical signals, but Dr. Walker expects to expand that capability to tens of thousands of compounds.

While the silicone wristbands measure external exposures, they lack the ability to measure internal dose or biological response to environmental compounds. Megan Niedzwiecki, PhD, Assistant Professor of Environmental Medicine and Public Health at the Icahn School of Medicine, has recently shown that advances in microneedle patches, which can be worn on the upper arm, mean the patches can be used to collect biomarkers of harmful environmental compounds and alterations in metabolic pathways associated with those exposures. The patches, which were developed from flu vaccine patches that were re-engineered to passively collect and store interstitial fluid rather than deliver the vaccine, provide an innovative method for collecting fluid surrounding cells that carry important nutrients and metabolites.

Dr. Walker and Dr. Niedzwiecki are currently collaborating on a project with researchers at Columbia University and Georgia Institute of Technology in which participants wore microneedle patches to collect their own interstitial fluid. The researchers compared traditional blood samples with the interstitial fluid collected by the patches and found high levels of correlation between metabolite levels, in addition to detecting chemicals arising from environmental and dietary exposures.

Silicone wristbands and microneedle patches may help provide an improved understanding of an individual's environmental exposures and how their body processes those compounds, perhaps enabling doctors to detect previously unknown health risks and understand how a medicine may act differently from patient to patient. The two methods are low-cost, easy to prepare, and can be sent through the mail.

Until now, researchers have relied on targeted analytical methods to measure exposure biomarkers and exposure effect



Wearable bracelets can potentially absorb tens of thousands of compounds in a person's daily orbit.

in blood and urine samples. Sample collection often requires costly training of personnel, and targeted methods require researchers to pre-select a small number of compounds they want to study, which has limited the number of well-understood environmental compounds to fewer than 100.

Routine collection methods also have mostly been unable to pinpoint exposures at the individual level. Satellite data can be used to assess external exposure, such as to air pollution. However, satellites cannot account for localized exposures caused by cooking, or by a person's movements throughout the day.

"We expect that there are hundreds of thousands of environmental exposures over a person's lifetime," Dr. Walker says. "Current approaches only allow us to measure a handful of those at a time. We've found the silicone wristbands and microneedle patches to be powerful tools. The hope is that these samplers will be distributed to a large number of people over different time periods. When you have that much more granularity and ability to assess comprehensive exposures, you can look at disease outcomes with more accuracy."

Environmental Pediatric Clinic Offers Patients the Expertise of Researchers at Icahn School of Medicine at Mount Sinai

One-year-old Mile's blood test revealed abnormally high lead levels, and his mother wanted to know why. Nanci Pavlisko spent more than a year testing materials from her son's everyday life for lead, including turf from a nearby playground and even the family dog. Results came up inconclusive. She worried about what the high lead levels meant for Miles' development.

Then she met Lauren Zajac, MD, MPH, Assistant Professor in the Department of Environmental Medicine and Public Health and the Department of Pediatrics at the Icahn School of Medicine at Mount Sinai. Dr. Zajac has launched the Environmental Pediatrics Clinic, one of

Dr. Zajac offered specialized knowledge about lead poisoning that the child's pediatrician hadn't been aware of, including the fact that it may take several years for his lead tests to show lower numbers after the exposure is eliminated. This information helped Ms. Pavlisko to not fret every three months when her son had a blood test.

"The clinic workers were such a source of comfort and reassurance. You feel so helpless. I felt confident that we had absolute experts on the topic who were intimately familiar with his case. I hope that parents know that this resource is available," she says. Dr. Zajac continues to monitor Miles, who is now 3.

Pediatrics, at the Icahn School of Medicine. Dr. Sheffield holds the position of Assistant Professor and Dr. Galvez is an Associate Professor.

The Clinic staff also includes Erin Thanik, MD, MPH, an Assistant Professor in the Department of Environmental Medicine and Public Health at the Icahn School of Medicine at Mount Sinai, a pediatric physician who specializes in allergy and immunology, along with a social worker and an industrial hygienist. The team works together to assess individual children's risks and problems associated with environmental exposure to toxins including mold, air pollution, and lead.

"Mount Sinai does a lot with environmental health and the exposome in terms of cutting-edge research, teaching, and scholarship," says Dr. Zajac. "Our new clinic is the clinical arm of these efforts, which puts that scholarly activity into action for patients. I'm very excited, because opening this clinic has been a dream of ours for so long."

The clinic is a brick-and-mortar extension of Dr. Zajac's experience and that of her colleagues over more than a decade operating a federally funded environmental exposure hotline known as the Pediatric Environmental Health Specialty Units program. Mount Sinai Health System, through Drs. Zajac, Sheffield, and Galvez, has served as the program's leader for federal Region 2, which covers New York, New Jersey, Puerto Rico, and the U.S. Virgin Islands, offering free consultation and guidance to families, health care providers, and public health agencies regarding prevention and management of harmful environmental exposures in children and reproductive-age adults.

Now, children and their caregivers can make in-person visits to an exceptional team of pediatric environmental exposure experts at the Environmental Pediatrics Clinic, which focuses on prevention.

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Lauren Zajac, MD, MPH, directs the Environmental Pediatrics Clinic which provides clinical evaluations for children with known or suspected exposures to environmental toxins.

only a few centers in the United States with the sole mission of reducing children's exposure to harmful environmental conditions. In January 2018, Dr. Zajac spent two hours examining Miles and educating Ms. Pavlisko and her husband about lead poisoning.

"In our whole journey, that was the first day I felt reassured that Miles would be okay," says Ms. Pavlisko.

The Environmental Pediatrics Clinic, located in the Mount Sinai Selikoff Centers for Occupational Health, is open on Fridays and offers evidence-based consultations via in-person visits and internet-enabled video consultations. Dr. Zajac heads the clinic along with two other Mount Sinai environmental pediatricians, Perry Sheffield, MD, MPH, and Maida Galvez, MD, MPH. Both teach in the Department of Environmental Medicine and Public Health, and the Department of

New Outbreak Forecast Model to Help Public Health Departments

A new outbreak forecast model has been developed to help public health departments better prepare for a zoonotic spillover event, which occurs when a reservoir animal population with a high pathogen prevalence comes into contact with humans. Nicholas DeFelice, PhD, Assistant Professor in the Department of Environmental Medicine and Public Health at the Icahn School of Medicine at Mount Sinai, has already proven that his model works on West Nile virus, an infectious disease that could become a bigger threat as global warming continues to cause climate change.

DeFelice has been collaborating for the past two years with several mosquito abatement districts and health departments around the country, including Suffolk County, New York, to generate real-time disease outbreak forecasts for West Nile virus. The model assimilates data taken from trapped mosquitos, human West Nile virus infections, and the local climatology.

Retrospectively, the model has been able to make an accurate snapshot of virus spillover from mosquitos to humans up to nine weeks prior to the last reported human case and 11 weeks prior to the end of mosquito monitoring.

“We’re able to generate accurate forecasts of the prevalence of infectious mosquitoes even while the outbreak is ongoing, by using a parsimonious model of West Nile virus disease transmission dynamics and disease monitoring data to provide agencies with a calibrated probability of how the outbreak may progress,” says DeFelice, who became interested in West Nile virus as a runner living in Sacramento, California, in 2005. He jogged at dusk, when mosquitoes are active. His father, an infectious disease doctor, had documented West Nile virus cases.

West Nile virus was first recorded in the United States on Long Island in 1999, with 66 cases that year. By 2003, the virus had

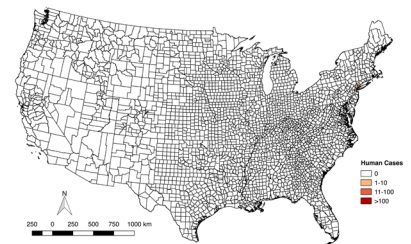
spread to California, and nationwide that year, approximately 10,000 cases were recorded. Most infected people are asymptomatic and only a fraction of the symptomatic cases are reported. Flu-like symptoms occur in 1 in 4 infected people. In rare cases, or 1 in 250 West Nile virus infection cases, the virus causes neurological damage, which ends in death in about 10 percent of these patients.

Vector-borne diseases account for roughly 17 percent of all infectious diseases in humans, according to the World Health Organization. Since 2014, major vector-borne disease outbreaks have included Dengue, Malaria, Chikungunya, Yellow Fever and Zika, occurring primarily in tropical regions, but West Nile virus is different because it has spread to a vast region of the globe and is now considered the most important cause of viral encephalitis worldwide. As climate changes continue as a result of global warming, summers will potentially last longer in the northern hemisphere and extend West Nile virus season into early November, says DeFelice.

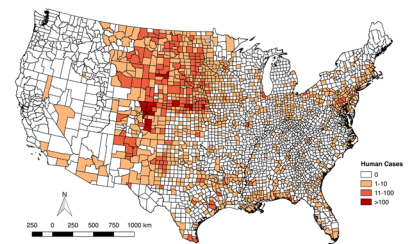
DeFelice is currently trying to improve the model by incorporating ecological data such as humidity and soil moisture along with land use data, collected via satellite, in collaboration with Alan Just, PhD, Assistant Professor in the Department of Environmental Medicine and Public Health.

“We hope to develop a finer-resolution forecast,” says DeFelice. “Currently, our forecasts describe conditions at a county level. One question that comes up while discussing this with mosquito abatement officials is how do we provide, within space and time, better guidance as to which area of the city the outbreak is progressing.”

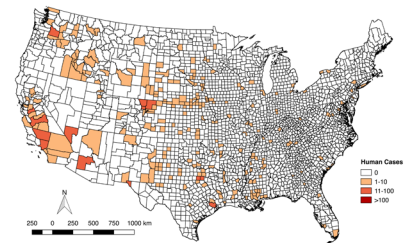
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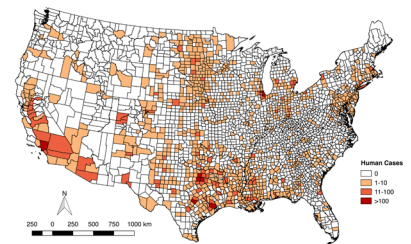
2003



2009



2012



West Nile virus was first identified in North America in Long Island during the summer of 1999, and by 2003 had spread throughout the continent and established itself as the leading cause of domestically acquired arthropod-borne viral (arboviral) disease in the United States.

In 2012, human cases of West Nile virus surged to numbers not seen since 2003 suggesting that it will continue to produce unpredictable local and regional outbreaks throughout the US. This enormous variability makes public health allocation decisions difficult, and highlights the utility of an accurate forecast.



From left to right: Rosalind Wright, MD, MPH, and Robert Wright, MD, MPH, Co-Directors of the Mount Sinai Institute for Exposomic Research; Dennis Charney, MD, Dean of the Icahn School of Medicine at Mount Sinai; David Balshaw, PhD, and Claudia Thompson, PhD, National Institutes for Environmental Health Sciences

Meet the Co-Directors of the Mount Sinai Institute for Exposomic Research



Robert O. Wright, MD, MPH, Co-Director of The Institute for Exposomic Research, is a pediatrician, epigeneticist, and environmental epidemiologist at the Icahn School of Medicine at Mount Sinai. He is the Ethel H. Wise Chair of the Department of Environmental Medicine and Public Health, and is the Founder and Director of the Senator Frank R. Lautenberg Health Sciences Laboratory.



Rosalind J. Wright, MD, MPH, Co-Director of The Institute for Exposomic Research, is a pulmonologist and critical care physician, and international leader in life course epidemiology at the Icahn School of Medicine at Mount Sinai. She is the Dean for Translational Biomedical Research, holds the Horace W. Goldsmith Professorship in Children's Health Research, and is Professor of Pediatrics at Kravis Children's Hospital.

Inaugural Exposome Symposium

The Mount Sinai Institute for Exposomic Research held its inaugural Exposome Symposium on November 2-3, 2018. The program focused on the emerging field of exposomics and how this new science is revolutionizing how we understand disease and develop new strategies for prevention and treatment. Researchers are reconstructing early environmental exposures using novel methods, big data, and new technologies to understand health and disease.

More than 180 participants from academia, government, and industry attended from more than 24 U.S. states and 9 other countries, including Austria, Brazil, Canada, Finland, Greece, Israel, Japan, Thailand, and the United Kingdom. Symposium presentations covered new methodologies, current research and collaborations, and future directions.

"We have to rethink how we do research and accept that measuring the environment is a critical piece of the puzzle," said Robert O. Wright, MD, MPH, Co-Director of the Institute for Exposomic Research and Ethel H. Wise Chair of the Department of Environmental Medicine and Public Health at the Icahn School of Medicine at Mount Sinai.

The prevalence of chronic illnesses, such as neurodevelopmental disorders, asthma, cardiovascular disease, cancer, obesity, and diabetes is increasing, and growing evidence indicates that environmental exposures in early life are important causes.

Traditional environmental research has so far focused on a relatively small number of chemicals and addressed them one at a time. But almost nothing is known about health effects from the remaining hundreds of thousands of natural and man-made chemicals. To fit the puzzle pieces together, says Dr. Wright, we must embrace a large-scale, systematic approach to environmental science, known as exposomics.

"We work both on the external and the internal exposome. We use traditional lab based methods as well as non-traditional methods that employ computer science, geospatial modeling, public data mining, and the use of smartphone-based apps," says Dr. Wright. "The growth of systems biology has illustrated the importance of considering multiple risk factors simultaneously and measuring the biological pathways they affect, as well as the limitations of solely taking reductionist approaches to science in a rapidly changing world."

Support for the symposium was provided by Agilent Technologies, the Mount Sinai Environmental Health Sciences (EHS) Core Center (P30ES023515) and the Children's Health Exposure Analysis Resource (CHEAR) (U2CES026561).

Educating Communities through the Children's Environmental Health Center

The Children's Environmental Health Center (CEHC) is the organization within the Mount Sinai Institute for Exposomic Research that communicates groundbreaking research on exposomics and children's environmental health to the general public, both locally and nationally. The Center connects our science to a growing national movement of supporters and communities committed to ensuring a healthier future for all.

Our faculty participate in community events to foster communication and collaboration with the communities we serve and educate them on the role of environmental exposures in children's health and strategies to build healthier environments.

In 2019, we partnered with the nonprofit organization Beyond Pesticides to host a community forum April 5-6 about organic land management practices for city parks and green spaces. The event explored strategies to protect communities from toxic pesticides and included panel discussions with leading researchers and advocates, field trips to The Battery Conservancy and Wagner Houses Farms, and a film screening of the documentary "Ground War." Collaborations like these have driven our success to educate new audiences since the Center's inception a decade ago.

Thanks in part to the philanthropic support of the Center and other major donors, Mount Sinai leads the field both in discovering environmental causes of disease and reinventing the science on how we approach the complex impact of the environment on human health throughout the full life course. In addition to holding community events, the Center produces educational materials for parents, caregivers, and community members so they may make more informed decisions that protect the health and development of all children.

To learn more about the Center and to join the community, visit www.cehcenter.org.



A Decade of Community Education *Winter Symposia*

- Pesticides and Children's Health, 2019
- Understanding the Exposome, 2018
- Decade of the Developing Brain, 2017
- Chemicals and Allergens in the Foods We Eat, 2016
- Breast Cancer and the Environment, 2014
- Stress and the Environment, 2013
- Chemicals and the Developing Brain, 2012
- Birth Defects, Learning Disabilities, Obesity, 2011
- Environmental Causes of Autism, 2010
- Breast Cancer, Puberty & Endocrine Disruptors, 2009

Follow the Children's Environmental Health Center



Follow the Institute for Exposomic Research



Mount Sinai Partners of The Institute for Exposomic Research

- Transdisciplinary Center on Early Environmental Exposures (TCEEE)
- Children's Health Exposure Analysis Resource (CHEAR)
- Environmental Influences on Child Health Outcomes (ECHO)
- The Children's Environmental Health Center (CEHC)
- Environmental Pediatrics Clinic
- New York State Children's Environmental Health Center

Laboratories

- The Senator Frank R. Lautenberg Environmental Health Sciences Laboratory
- Physical Assessment of Children's Environmental Risk Laboratory (PACER)



Two Postdoctoral Fellows Studying the Development of the Microbiome from In Utero to Childhood

Two postdoctoral fellows at the Mount Sinai Institute for Exposomic Research, **Rebecca Campbell, PhD, MSPH**, and **Ryan Walker, PhD** are studying the development of the microbiome from *in utero* to childhood, and associated health outcomes.

Dr. Campbell is working in the research group of Rosalind Wright, MD, MPH, Dean for Translational Biomedical Research at the Icahn School of Medicine at Mount Sinai and Co-Director of the Institute for Exposomic Research, to discover how maternal stress during pregnancy may have long-lasting neurocognitive and immune effects in children, including increasing the risk of asthma. Dr. Campbell plans to link maternal stress data with newborn fecal samples to determine whether a relationship can be detected between maternal stress and infant gut bacteria composition. The children are enrolled in a cohort study in which their health outcomes will be measured throughout childhood, so that the microbiome measurements around time of birth can be connected to later health conditions.

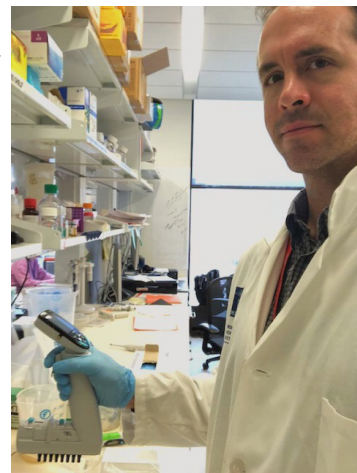
“I came to Mount Sinai because I was really interested in fetal development and prenatal environmental exposures, and the opportunity to study with Dr. Wright in these established, multiethnic urban cohorts is a unique opportunity,” says Dr. Campbell.

Dr. Walker has been studying a birth cohort of 40 mother-father-infant triads based in Barcelona, Spain, as a researcher in the laboratory of Ruth Loos, PhD, Professor of Environmental Medicine and Public Health at the Icahn School of Medicine.

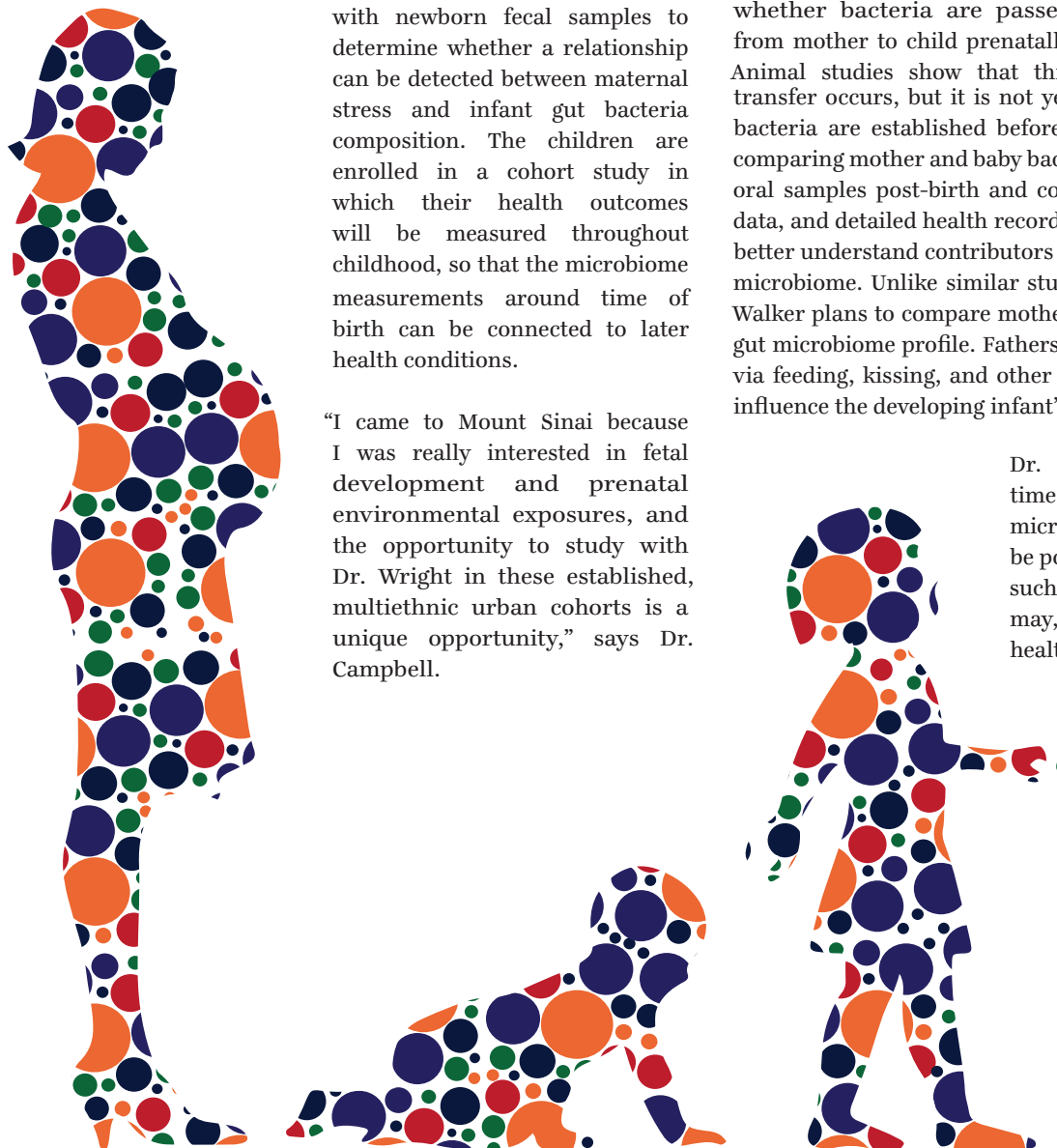
Dr. Walker plans to compare pregnant mothers’ amniotic fluid, cord blood, and placental samples with the earliest stool samples of the baby to determine whether bacteria are passed from mother to child prenatally. Animal studies show that this transfer occurs, but it is not yet clear in humans whether the gut bacteria are established before birth or after. Dr. Walker is also comparing mother and baby bacterial samples using stool, skin, and oral samples post-birth and collecting breast milk, infant feeding data, and detailed health records, including antibiotics exposure, to better understand contributors to the development of children’s gut microbiome. Unlike similar studies, which overlook the father, Dr. Walker plans to compare mother and baby results with the father’s gut microbiome profile. Fathers may pass bacteria to their children via feeding, kissing, and other close contact, he says, which could influence the developing infant’s gut bacteria.

Dr. Walker aims to identify critical time windows of exposure in early gut microbiome development, which could be positively influenced by interventions, such as dietary or probiotic, that may, in turn, improve future children’s health outcomes.

“At the time I came to Mount Sinai, there was a paucity of well-designed prospective clinical cohorts and clinical trials in microbiome research,” says Dr. Walker, Postdoctoral Fellow, Environmental Medicine and Public Health, Charles Bronfman Institute for Personalized Medicine. “I knew that by coming here, I could forge those collaborations and that it would be a fruitful experience, and it has been.”



Ryan Walker, PhD



Three Faculty Members Receive R01 Grant Funding

In 2018, the National Institutes of Health (NIH) awarded three of its prestigious R01 grants, which provides funding for four or five years, to three faculty members at the Institute for Exposomic Research at the Icahn School of Medicine at Mount Sinai. They are: Sonali Bose, MD, MPH; Megan Horton, PhD, MPH; and Alison Lee, MD, MS.



Dr. Sonali Bose, Assistant Professor of Medicine (Pulmonary, Critical Care, and Sleep Medicine), and Pediatrics at the Icahn School of Medicine at Mount Sinai, is a pulmonologist studying the link between maternal air pollution exposure during pregnancy and sleep problems in early childhood. Dr. Bose piloted an innovative protocol that enables sleep monitoring of children within their home environment. She is measuring sleep quality of 450 preschoolers in New York City over a one-week period to understand the role that prenatal air pollution exposure plays in human sleep development. Dr. Bose is working with subjects within a prenatal cohort study known as Programming of Intergenerational Stress Mechanisms (PRISM) in the laboratory of Rosalind Wright, MD, MPH, Dean for Translational Biomedical Research at the Icahn School of Medicine and Co-Director of the Institute for Exposomic Research.

“The effects of prenatal air pollution exposure on the development of sleep are understudied,” Dr. Bose says. “We know that children from lower-income populations experience a disproportionate burden of sleep problems. We suspect that sleep disorders in children have very early origins, and prenatal environmental exposures may be playing a role.”

Poor sleep in children is linked to behavioral and cognitive problems, as well as physical health issues. Identifying early environmental risk factors may be critical to promoting optimal healthy sleep, according to Dr. Bose.



Dr. Alison Lee, Assistant Professor of Medicine (Pulmonary, Critical Care and Sleep Medicine), and Pediatrics at the Icahn School of Medicine, is a pulmonologist studying links between maternal environmental exposures, including maternal trauma, and children’s respiratory problems.

Prior research has established that minority women living in socioeconomically disadvantaged areas are at least five times more likely to experience physical abuse compared with women nationally. A study led by Dr. Rosalind J. Wright found that 60 percent of women in these populations have experienced sexual or physical abuse. At the same time, childhood asthma rates in these same neighborhoods is typically high.

For her study, Dr. Lee is analyzing 400 mother-infant pairs from low-income, ethnically diverse neighborhoods. Dr. Lee uses a self-reported questionnaire to record prenatal depression and symptoms of post-traumatic stress disorder (PTSD). She tests maternal blood drawn in mid-pregnancy and cord and placental tissue at delivery for placental microRNA, a potential marker of early predisposition to childhood respiratory disorders. She then plans to analyze whether maternal trauma, via placental microRNA signaling, is associated with child wheeze, asthma, and reduced lung function through age 4.

Maternal trauma can alter functioning of the placenta, which plays a major role in immune, neuroendocrine, and autonomic function as well as oxidative stress systems, she has found. These key regulatory systems are central to lung development *in utero*.

“This study builds on our prior work demonstrating associations between maternal stress and child respiratory outcomes. The novel and exciting concept for this grant hinges on the concept that the placenta is the maternal-fetal interface and that maternal trauma and stress can influence how the placenta is functioning,” says Dr. Lee. “If we can understand the role of the placenta in directing future respiratory disease, we may be able to develop a biomarker of prior trauma and future disease risk.”

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Educating Providers on Impacts of Climate Change

Climate change is taking a toll not just on the environment, but also in the clinic, with a rise in asthma, cardiovascular disease, insect-borne viruses, and heat-related death. That was the urgent message of the inaugural Clinical Climate Change conference, hosted by Mount Sinai's Institute for Exposomic Research. Panelists at the event, held on Saturday, January 12, at the New York Academy of Medicine, included environmental advocates and leaders in the study of environmental medicine and public health.

The conference aimed to provide public health professionals, policymakers, physicians, nurses, medical students, and allied health professionals with a base of up-to-date evidence to inform patient treatment and care as the global average temperature continues its steady rise. "Air pollution is a major driver of the health consequences of climate change," said Robert O. Wright, MD, MPH, Professor and Ethel H. Wise Chair of the Department of Environmental Medicine and Public Health, and Co-Director of the Institute for Exposomic Research, Icahn School of Medicine at Mount Sinai. "In addition to conditions you would expect to increase, such as asthma and other lung diseases, our research shows that there are many downstream effects." For example, Dr. Wright and several other panelists focused on fine particulate matter (PM2.5) from air pollution, which causes inflammation in the body that is associated with neurotoxicity, neurodevelopmental disorders, and increased insulin resistance.

"Heat-related conditions are of particular concern for outdoor workers. Thousands become sick every year, and many die, due to these preventable illnesses," said Roberto Lucchini, MD, Professor of Environmental Medicine and Public Health, Icahn School of Medicine. "Studies show that recurrent heat exposure, with physical exertion, inadequate hydration, and exposure to chemicals, can lead to chronic kidney disease," he said. "There is an epidemic of this disease among worker populations in Central America. We have to prepare health care workers in northern areas to be aware of the condition."

In addition to these critical warnings, speakers presented actionable tools for clinicians both to better inform patients and to modify their practice. "Physicians can explain the importance of paying attention to heat and poor air-quality days," said Emily Senay, MD, MPH, Assistant Professor of Environmental Medicine and Public Health, Icahn School of Medicine. "This is especially important for vulnerable patients who are elderly or chronically ill." During a heat wave, clinicians might consider adjusting some medications, like diuretics, which reduce the ability to lose heat by sweating. And they should advise patients to close windows

and use air conditioning to limit exposure to air pollution but also to be conscious of indoor pollutants like mold and fumes from cleaning products.

Physicians were encouraged to prepare for an influx of diseases previously unseen in their population, particularly those carried by insects. A warming climate will make habitats more hospitable to disease-carrying insects, such as mosquitoes and ticks, exposing a larger swath of the population to diseases such as Lyme disease, Zika virus, and dengue fever.



Attendees gathered at the New York Academy of Medicine.

Another concern is that weather events, such as hurricanes and floods, are becoming more extreme as a result of climate change. Superstorms of recent years, like Hurricane Sandy, are leading to a shift from an "emergency response" model to a more forward-looking "risk mitigation" approach, said George Loo, DrPH, MPH, Assistant Professor of Emergency Medicine, and Population Health Science and Policy, Icahn School of Medicine. That includes moving critical infrastructure out of flood prone areas and developing extensive logistics for managing transportation, power, security, and staffing. In addition, Dr. Loo said, "Health care workers need to first have a plan to take care of themselves and their families. Knowing that your family is safe and that you have a way to contact them will reduce stress and help you focus on your patients."

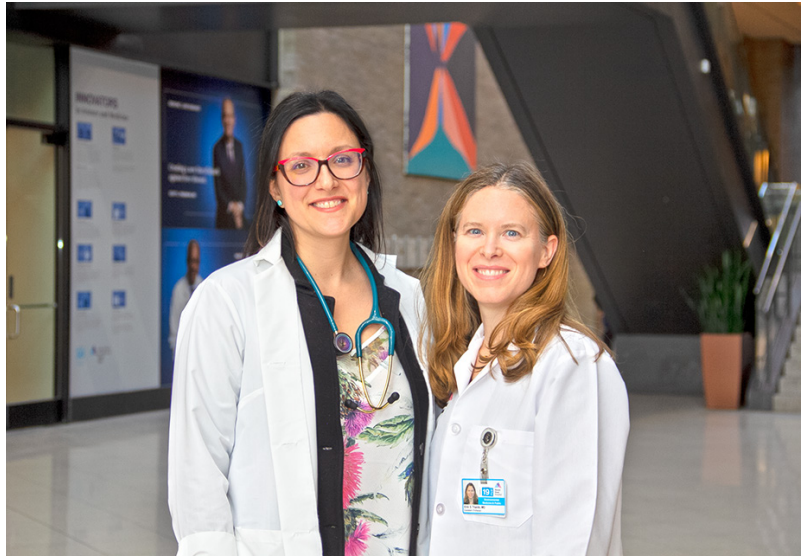
"Physicians play an important role in helping patients understand how climate affects the health of individuals and how, at a population level, humans affect the environment," Dr. Senay said. "With a nuanced approach," she added, "providers can improve environmental literacy and open the door to discussions about how walking more, eating a plant-based diet, and advocating for renewable energy can make both the planet and patients healthier."

The next climate change conference is planned for January 2020.

Environmental Pediatric Clinic Offers Patients the Expertise of Research at the Icahn School of Medicine at Mount Sinai *continued from page 4*

Dr. Thanik is leading an effort to locate at-risk patients and refer them to the Clinic, in collaboration with Mount Sinai pediatric specialists such as allergists and pulmonologists. In New York City, for example, many children live in homes with asthma triggers. Medication alone may not optimally help children if they live in homes with mold or roaches, Dr. Zajac says. Her team connects families with community resources that help with in-home interventions to reduce environmental triggers.

Dr. Zajac, Dr. Thanik and their colleagues have also been heading a pioneering effort by New York State over the past year to launch a statewide network of pediatric environmental health centers. The network, known as the New York State Children's Environmental Health Centers, consists of newly assembled teams of dedicated children's environmental health champions located in children's hospitals across the state. These teams offer clinical management, along with outreach and education, to reduce harmful environmental effects on children's health. Centers are located throughout New York State in Albany, Buffalo, Long Island, New York City, Rochester, Syracuse, and Westchester County. Mount Sinai Health System serves as the state's coordinating center, responsible for building statewide capacity and growing the network so that all New York children are served.



Lauren Zajac, MD, MPH, and Erin Thanik, MD, MPH

The federal and state programs—and now Mount Sinai's local clinic—help make it easier to keep children safe.

“We want to augment medical management to address environmental asthma triggers, provide patient education, and connect high-risk asthmatics with evidence-based interventions provided by community-based organizations,” says Dr. Thanik. “We are able to address environmental concerns at a deeper level than is possible during the confines of a typical office visit.”

Three Faculty Members Receive R01 Grant Funding *continued from page 9*



Megan Horton, PhD, MPH, Assistant Professor of Environmental Medicine and Public Health at the Icahn School of Medicine at Mount Sinai, is studying the association between metals exposure in the womb and just after birth with structural and functional brain abnormalities associated with anxiety and depression symptoms in children ages 8-12.

Dr. Horton combines magnetic resonance imaging (MRI) scans from 250 children within the longitudinal Programming Research in Obesity, Growth, Environment and Social Stressors (PROGRESS) cohort in Mexico City—established by Robert O. Wright, MD, Ethel H. Wise Chair of the Department of Environmental Medicine and Public Health (EMPH) at the Icahn School of Medicine and Co-Director of the Institute for Exposomic Research—with early life exposure information gleaned from analysis of the children's baby teeth, in collaboration with Manish Arora, PhD, Professor and Vice Chair of EMPH. Dr. Arora's team published a groundbreaking study in 2018 that showed that abnormal absorption levels of metals including manganese, zinc, and lead during the second and third trimesters and post-birth are associated with a later

diagnosis of autism spectrum disorder (ASD). Baby teeth grow much like tree rings and contain information allowing reconstruction of previous exposures to environmental toxicants, in some cases at weekly resolution.

Previous research led by Dr. Horton concluded that higher manganese and lead exposures are associated with functional changes in the brain areas responsible for emotional regulation. Manganese is found in food as well as in air pollution and contaminated dust. For her R01 grant, Dr. Horton is extending initial pilot research to a larger sample size.

“This grant is informative and innovative because it leverages data from Dr. Arora's teeth studies with data from MRI scans so that we can look at the retrospective history of exposure to fetus and child and determine how that impacts brain development at 8 to 12 years of age,” says Dr. Horton.

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The Mount Sinai Institute for Exposomic Research

The Institute for Exposomic Research at the Icahn School of Medicine at Mount Sinai is the world's first research institute devoted to the intensive study of the exposome, or the totality of environmental influences on human health. The mission of the Institute is to understand how the complex mix of nutritional, chemical, and social environments affect health, disease, and development later in life and to translate those findings into new strategies for prevention and treatment.

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