Break the Cycle
of Environmental Health Disparities

Thursday, May 6, 2010
8:30 am - 4:00 pm

Woodruff Health Sciences Administration Building (WHSCAB)
Emory University
1440 Clifton Road,
Atlanta, Georgia 30322

A project of
Southeast Pediatric Environmental Health Specialty Unit
at Emory University

Keynote Speaker: Carol J. Rowland Hogue, PhD, MPH, Rollins School of Public Health, Emory University
Speaker: Henry Slack, P.E., Environmental Protection Agency, Region 4
Student Researchers from eight universities will present findings from their research
Conference Program

8:00 – 8:30  Registration

8:30 – 9:00  Welcome & Introduction to Break the Cycle – I. Leslie Rubin

9:00 – 9:30  Environmental Health Disparities in Vulnerable Children
  Keynote Speaker: Carol J. Rowland Hogue

9:30 – 10:00  Environmental Impact of Minority Children Residing in Economically Disadvantaged Communities
  Clark Atlanta University, School of Social Work
  Shava Cureton, Student; Sandra Foster, Faculty Mentor

10:00 – 10:30  Second Hand Smoke Exposure in Children: An Evaluation of Psychological & Physiological Effects
  George Washington University School of Medicine & Health Sciences, Department of Pediatrics and Environmental Health
  Zoya Treyster, Student; Benjamin Gitterman, Faculty Mentor

10:30 – 10:45  Health Break

10:45 – 11:15  General Knowledge of Mercury Exposure to Women of Childbearing age in Duval County, Florida
  University of Florida, College of Medicine and College of Public Health
  Victoria Chau, Student; David Wood and Katryne Lukens-Bull, Faculty Mentors

11:15 – 11:45  Planning for Healthy Homes Assessments in North Carolina
  University of North Carolina-Chapel Hill, Gillings School of Global Public Health
  Lindsay Herendeen, Student; Amy MacDonald, Faculty Mentor

11:45 – 12:45  Lunch and Networking

12:45 – 1:15  Ways to Care for your Air: Air inside the Built Environment and Common Pollutants in it
  Speaker – Henry Slack

1:15 – 1:45  Pesticide Exposure and Perceptions on the Effect of Environmental Factors on Childhood Obesity
  Mercer University School of Medicine, Department of Community Medicine
  Claudia Twum, Student; Yudan Wei, Faculty Mentor

1:45 – 2:15  Legal Analysis of Childhood Obesity and the Built Environment in Minority and Low-Income Populations
  Georgia State University, College of Law
  Raymond Lindholm, Student; Charity Scott, Faculty Mentor

2:15 – 2:30  Health Break

2:30 – 3:00  The Relationship Between the Built Environment & Birth weight in Central Durham, NC
  Duke University, Children’s Environmental Health Initiative
  Rebecca Ouyang, Student; Martha Keating and Pamela Maxson, Faculty Mentors

3:00 – 3:30  “Greening” School Buildings in Disadvantaged Communities
  Georgia Institute of Technology, Department of Architecture
  Selen Okcu, Student; Erica Ryherd and Charlene Bayer, Faculty Mentors

3:30 – 4:00  Summary of Break the Cycle projects – what’s next?
Conference Faculty and Presenters

Keynote Speakers
Carol J. Rowland Hogue, PhD, MPH
Rollins School of Public Health, Emory University

Dr. Carol Hogue was appointed Professor of Epidemiology and Jules & Uldeen Terry Professor of Maternal and Child Health at the Rollins School of Public Health of Emory University in 1992. For a decade before that, she was at the Centers for Disease Control, Division of Reproductive Health, where she was chief of the Pregnancy Epidemiology Branch (1982-88) and then Director of the Division (1988-1992). Prior to her government service, she was on the Biometry faculty of University of Arkansas for Medical Sciences College of Medicine (1977-82) and the Biostatistics faculty of UNC-CH School of Public Health (1974-77). While at CDC, Dr. Hogue initiated many of the current CDC reproductive health programs, including the Pregnancy Risk Assessment Monitoring System (PRAMS), the National Pregnancy Mortality Surveillance System, and the National Infant Mortality Surveillance (NIMS) project that initiated the national and state-level development and use of linked birth and death records. In addition, Dr. Hogue led the first research on maternal morbidities that was the precursor to the current safe motherhood initiative, and the initial innovative research on racial disparities in preterm delivery that found that college-educated African American women have a three-fold risk of very preterm delivery, when compared to college-educated white women. This discovery has triggered further research into biological, biosocial, and environmental causes of this as-yet unexplained excess risk.

Her ongoing research interests include the long-term effects of induced abortion, epidemiology of preterm delivery, and the impact of pregnancy complications on minority health. She has published broadly in maternal health, including studies of ectopic pregnancy, stillbirth, unintended pregnancy, contraceptive failure, and reproductive cancers. She is lead editor of the book, Minority Health in America (Johns Hopkins U. Press, 2000) and of a 2001 supplement to the journal Paediatric and Perinatal Epidemiology, entitled “New Perspectives on the Stubborn Challenge of Preterm Birth.” Currently she is PI of the Emory Center in the NICHD-funded Stillbirth Collaborative Research Network as well as co-PI of the Emory National Children’s Study Center. She is also leading intervention research into reducing obesity among African American women healthcare workers, funded by CDC and USDA. Among her many honors, Dr. Hogue served as President of the Society for Epidemiologic Research (1988-89), served on the Institute of Medicine Committee on Unintended Pregnancy (1993-1995), was Chair of the Regional Advisory Panel for the Americas of the World Health Organization Human Reproduction Programme (1997-99), President of the American College of Epidemiology (2002-4), Senior Fellow of the Emory Center for the Study of Law and Religion (2001-6), and received the MCH Coalition’s National Effective Practice Award in 2002. Dr. Hogue is a long time supporter of the Break the Cycle projects and has mentored students in two of the Break the Cycle rotations. She serves on the ISDD Advisory Council.

Henry Slack, P.E.
Environmental Protection Agency, Region 4
Presenter

Since 1991, Henry Slack, P.E., has managed the Indoor Air Program for the U.S. Environmental Protection Agency (EPA), Region 4, which covers eight southeastern states. In this position, he offers expertise concerning indoor air to citizens or public agencies with questions on topics as diverse as mildew, odors, carbon monoxide, carpets, air cleaners, and secondhand tobacco smoke. He also plans and conducts special projects, such as the creation of an indoor air video, and is a member of the Science Advisory Teams that meets in maternal health and advises the Indoor Environments Division managers on scientific issues. The EPA program is non-regulatory. Mr. Slack had a temporary assignment to the CDC National Center for Environmental Health, Air Pollution and Respiratory Health Branch, in 1998, where he investigated the use of unvented residential heating appliances (which could lead to carbon monoxide poisoning). The report was published in the Morbidity and Mortality Weekly Report in December 1998. In 2004, he was appointed a Fellow through Partners of the Americas, and spent a month and a half in Barbados training and assisting staff of the Barbados environmental agency.

In his previous position as the Energy Engineer for U.S. General Services Administration, Region 4, he was responsible for that agency's energy management program, including building inspections, energy studies, and monitoring of energy consumption. Mr. Slack's actions saved the Federal government hundreds of thousands of dollar a year. As an engineer, Mr. Slack has also designed rooftop air conditioning units for Seasons-4, Inc., a small manufacturer, and served as the Energy Coordinator at Fort McPherson in Atlanta. Mr. Slack earned a Bachelor of Science in Chemistry in 1974 from Southwestern at Memphis (now called Rhodes College) in Memphis, Tennessee, and a Master of Science in 1980 from Georgia Institute of Technology. He became a registered Professional Engineer in the state of Georgia in 1988.
Dr. Sandra Foster is an Associate Professor in the Whitney M. Young, Jr., School of Social Work at Clark Atlanta University and the Bandleader, Bassist and Vocalist for The SaNa Ba. She received her MSSW and PhD from the University of Wisconsin-Madison and has taught research methods, policy, human behavior in the social environment, and practice courses in Schools of Social Work at Stephen F. Austin State University-TX, Grambling State University-LA, University of Southern MS, Western Carolina University-NC, and University of California-PA. One of her research interest is the healing properties of artistic expression. Accordingly, she has developed and regularly presents a workshop on the Healing Properties of the Blues. This interactive workshop uses narration and song to trace the Blues from its African Roots to its American fruits. The workshop compares the healing properties of the Blues to the social work problem-solving method and offers implications for practice.

Student

Shava Cureton is obtaining a Master’s degree in Social Work at Clark Atlanta University. She received a Bachelor’s degree in Psychology at Clark Atlanta University, where she graduated summa cum laude. Ms. Cureton’s research focuses on environmental health disparities among children in which she examines the interplay between environmental justice issues and the health of children in economically disadvantaged areas. Ms. Cureton has also examined attitudes about how torture has impacted national security. In the future, Ms. Cureton would like to research the relationship between domestic violence and environmental factors. Ms. Cureton believes that it is crucial to research issues that people in all facets of life face every day and to use this information to make a difference.

Duke University, Children’s Environmental Health Initiative

Faculty

Martha Keating, MS

Martha Keating is an Associate in Research at CEHI where her work focuses primarily on community outreach and research translation. She holds a B.S degree from the University of New Hampshire and a M.S. in Environmental Science and Engineering from the School of Public Health at the University of North Carolina. Ms. Keating’s career includes 10 years as an environmental scientist with the U.S. Environmental Protection Agency where her work dealt with hazardous air pollutants and regulatory authorities of the Clean Air Act. She was the project director and a principal author of the EPA’s Mercury Study Report to Congress, for which she was awarded the EPA’s Silver Medal. In 1998, she founded Keating Environmental, a consulting firm whose work focused on power plant environmental impact issues, including mercury and other air toxics, and power plant combustion waste. Clients included numerous national, regional and state environmental advocacy groups. Martha Keating joined CEHI in October 2006 where her current interests are addressing health disparities and environmental justice issues through policy and regulatory change.

Pamela Maxson, PhD

Pamela Maxson is a Research Associate at CEHI where she is the Research Director for the Southern Center on Environmentally Driven Disparities in Birth Outcomes (SCEDDBO) and the research coordinator for CEHI's Clinical Obstetrics study. She received her B.S from the University of Hawaii and her M.S. and Ph.D. in Human Development and Biobehavioral Health from Pennsylvania State University. Her research interests lie in the interface of psychological, social, host, and environmental contributors to health. Specific interests include maternal and child health disparities including the societal, familial, and individual influences on outcomes. She has been teaching at Duke since 1995 focusing on child, adolescent, and lifespan development.
Rebecca Ouyang is a graduating senior, pursuing a double major in Public Policy and English, with a certificate in Health Policy at Duke University. She currently serves as an undergraduate research assistant at the Children’s Environmental Health Initiative (CEHI), which focuses on incorporating spatial analysis into their research on health outcomes of vulnerable populations. Rebecca became interested in neighborhood quality in the summer of 2008 when she worked as a field technician on a research team that went on foot into neighborhoods in central Durham to collect built environment data. Her research interests lie in racial health disparities and their socioeconomic causes. She hopes to continue her education and public health interests into an MPH after graduation.

Erica Ryherd is an Assistant Professor of Mechanical Engineering and adjunct to the College of Architecture at the Georgia Institute of Technology. Prior, she was a postdoctoral researcher in Occupational and Environmental Medicine at the Sahlgrenska Academy of Medicine in Gothenburg, Sweden. She received her Ph.D. in Architectural Engineering (AE) at the University of Nebraska, along with a Bachelor’s degree in AE and a minor in music from Kansas State University. Dr. Ryherd teaches and conducts research in areas such as sustainable building systems engineering, architectural acoustics, engineering noise control, aircraft noise, and human response. She has previous industry experience in both mechanical systems (HVAC) engineering and acoustical consulting which she integrates into her work. She holds a LEED AP (Leadership in Energy and Environmental Design Accredited Professional) credential. In 2006, Erica was awarded the Hunt Postdoctoral Fellowship from the Acoustical Society of America and in 2008 she received a “Top 5 New Faces of Engineering” citation from the American Society of Heating, Refrigerating and Air-Conditioning Engineers.

Charlene Bayer received her Ph.D. in Organic Chemistry from Emory University in 1981. As a Principal Research Scientist and head of the Environmental Exposures and Analysis Branch (EEAB) at the Georgia Tech Research Institute (GTRI), she has been responsible for numerous research projects in indoor environmental and exposure research. She teaches graduate level classes and conducts research into the indoor environment in schools and its relationship to greener environments and health, particularly focusing on respiratory disease. Additionally her research has focused on in mass spectrometric analyses of trace organic compounds in air, ing breath volatiles analysis for breast cancer detection; studying the relationship between exposures and asthma exacerbation, development of real-time monitoring sensor systems for personal exposure monitoring; and investigating indoor environmental quality and its impact on the environment, human exposures, and learning and productivity in schools.

Selen Okcu is a Ph.D. student currently studying in the Architecture, Culture and Behavior area of the Ph.D. Program Georgia Institute of Technology College of Architecture. She received both her Master’s degree in Design Computing and Bachelor’s degree in Architectural Design from Istanbul Technical University College of Architecture. She has been involved in research and teaching. For her post-graduate studies, she has been developing evidence-based-design (EBD) strategies. Her research interests include relating design to key user outcomes such as productivity and wellbeing; developing effective ways to measure environmental qualities of physical settings. In 2009, Selen was awarded a Newman Medal from the Acoustical Society of America for excellence in the study of architectural acoustics.

Charity Scott is Professor of Law with a joint appointment in Georgia State University’s College of Law and J. Mack Robinson College of Business, Institute of Health Administration. She also is the Director of the Center for Law, Health & Society at the College of Law. The Center oversees the law school’s health law program, which is ranked among the top ten health law programs nationally by U.S. News & World Report. Professor Scott is also a Faculty Fellow in Health Law with Emory University’s Center for Ethics. She is a member of the American Law Institute, and serves on the American Bar Association’s Governing Council for the Health Law Section and the Medical-Legal Partnership Working Group. She is also Past Chair of the Health Law Section of the State Bar of Georgia. Professor Scott earned her MSCM degree (conflict management) from Kennesaw State University in 2009, JD degree from Harvard Law School in 1979, and AB degree from Stanford University in 1973.
Student

Raymond Lindholm

Raymond Lindholm is currently in his second year of law school at Georgia State University College of Law, where he is concentrating his studies in the area of Health Law. Before entering law school, Raymond ran two award-winning businesses which he started while working on his music degree. The first was a school of music, called the Lindholm School, and the second was a business that provided live musical ensembles for weddings and corporate events, called Atlanta Classic Weddings. Raymond has almost twenty years of experience performing with orchestras and ensembles throughout the country, including the Rome Symphony Orchestra, the Atlanta Philharmonic, the Georgia State Symphony Orchestra, the Macon Symphony Orchestra, and the Santa Cruz Symphony Orchestra. In addition, Raymond has performed repeatedly with members of the Vega String Quartet and the Balkan String Quartet. Raymond received his Bachelor of Music degree from the Georgia State University School of Music with a performance certificate in Violin Performance. Raymond is also a certified teacher in the Suzuki Violin pedagogical tradition, and served on the Board of Directors for the Suzuki Association of Georgia. Raymond expects to earn his Juris Doctor degree in May 2011, and plans on pursuing a career in the field of health law. Raymond is a Tlingit Alaskan Native and a member of the Tlingit & Haida Indian Tribes of Alaska. He is married and has four children.

The George Washington University School of Medicine and Health Sciences
Department of Pediatrics and Environmental Health

Faculty

Benjamin Gitterman, MD

Benjamin Gitterman, MD is Associate Professor of Pediatrics and Public Health at George Washington University and Children’s National Medical Center in Washington D.C. His major activities include Children’s Environmental Health, Child Advocacy and Community health focused training and program development. He received his Bachelor of Science degree from City College of New York, and his M.D. degree from SUNY at Buffalo. He completed his Pediatrics residency and chief residency at the Residency Program in Social Medicine at Montefiore Hospital and Medical Center in New York. Prior to coming to Washington DC, he was the director of Ambulatory Pediatric Services for Denver Health and Hospitals and was on the faculty of the University of Colorado School of Medicine. In Washington D.C., he has been the Chair of General and Community Pediatrics at Children’s National Medical Center.

Dr. Gitterman is Co-Director of the Mid-Atlantic Center for Children’s Health and the Environment, one of 10 federally funded Pediatric Environmental Health Centers in the United States. He is a member of the Governor’s Council on Children’s Health and the Environment for the State of Maryland, the Scientific Advisory Board of the Environmental Protection Agency for Children’s Environmental Health and a liaison member to the Advisory Committee on Children’s Lead Poisoning and Prevention for the CDC. He has been a member of the American Academy of Pediatrics Committee on Children’s Environmental Health, and has written and spoken nationally and internationally in this area, particularly in regard to advocacy and education. He also co-directs the Specialty Track in Environmental Health at George Washington University School of Medicine.

Student

Zoya Treyster

Zoya Treyster received her undergraduate degree from The George Washington University in 2006. She is currently in her third year of medical school and is interested in pursuing a career in pediatrics and is particularly interested in the intersection of the science of medicine and the reality of medicine. She has observed recent developments on smoking cessation are not always utilized in clinical practice and has become interested in the negative health effects of smoking and second hand smoke exposure. Ms. Treyster believes that pediatricians have the power to change adult behavior leading her to produce a comprehensive review that would highlight recent developments and ways in which pediatricians can decrease exposure to second hand smoke in their patients.

Ms. Treyster is the recipient of Lynn and Ruth George scholarship, 2009, given to students interested in pursuing an international elective aimed at decreasing health disparities; the Sandy Kemp Scholarship, 2009, given to students active in international medicine to attend the Doctors for Global Health General Assembly meeting; recipient of Amster Scholarship, 2007 & 2009, given to students active in the Jewish community; and the MASA Scholarship, 2008, given to students interested in pursuing a yearlong activism program in Israel. After graduation, she will begin a pediatrics residency and plans to continue her involvement in environmental pediatrics.
Mercer University School of Medicine
Department of Community Medicine
Faculty

Yudan Wei, PhD, MD, MPH

Yudan Wei, PhD, MD, is an Assistant Professor of Community Medicine at Mercer University School of Medicine. She received her Ph.D. degree in Toxicological Genetics from Stockholm University, Sweden, a Medical Degree in Preventive Medicine from Harbin Medical University, China, and postdoctoral training at University of Cincinnati Medical Center. She has taught for MPH and MD programs for about 7 years and has over 15 years of research experience in the field of environmental health and toxicology. Her research work includes studies of molecular mechanisms of the combined effects elicited by exposure to chromium and PAHs, biomarkers of chronic arsenic exposure, breast cancer etiology and prevention, and environmental risk factors for low birth weight and childhood obesity. She has also conducted community-based interventions and research on removal of lead contamination, breast cancer education, and childhood obesity awareness. Dr. Wei has numerous publications and presentations in her field, and has actively engaged in international collaborations for teaching and research.

Student

Claudia Twum

Claudia Twum obtained a B.A. in Biochemistry from Hood College in Frederick, Maryland. She is currently a second year graduate student in the Master of Public Health Program at Mercer University School of Medicine. Ms. Twum’s research focuses on identifying environmental risk factors associated with childhood obesity by looking at pesticide exposure, the built, social, and family environment. Ms. Twum has also examined the relationship between air pollution and birth weight. She is a member of the Honor Society of Phi Kappa Phi. Ms. Twum is originally from Ghana, where she lived until she was 16 years of age. Ms. Twum participated in the Minority Health and International Research Training in summer of 2006 and 2007 in Tanzania and Nigeria, respectively. Her public health interests include epidemiology, maternal and child health, and infectious diseases. In the future, Ms. Twum hopes to extend her research to explore the factors affecting maternal and child health on the African continent.

University of Florida, Jacksonville
College of Medicine and College of Public Health
Faculty

Katryne Lukens Bull, MPH

Katryne Lukens Bull is a Research Administrator at the Center for Health Equity and Quality Research (CHEQR) at the University of Florida, College of Medicine-Jacksonville. Ms. Lukens-Bull earned her BA in French and Anthropology from Arizona State University and her MPH from the University of Arizona. She has worked in public health in Arizona, Washington State, and Florida at the state and local health level. She joined the University of Florida in 2003 and has worked on projects including the development of residency program curriculum, research, mentoring of students, grant writing, data analysis and fiscal management of grants. In her current position within CHEQR, Ms. Lukens-Bull supports interdepartmental grant writing and research development. Ms. Lukens-Bull has specific research interests in the areas of breastfeeding, early childhood care-giving and health outcomes, health literacy and child health equity.

David Wood, MD, MPH

David Wood, MD, MPH is a Professor in the Department of Pediatrics and is the Director of the Center for Health Equity and Quality Research (CHEQR) at the University of Florida, College of Medicine-Jacksonville. Dr Wood is also the Medical Director for the Jacksonville Health and Transition Services (JaxHATS) clinic for adolescents with special health care needs. Dr Wood attended Harvard University and then earned his MD and MPH at UCLA, where he also completed his residency. Dr Wood is Board Certified in both Pediatrics and Preventive Medicine and completed a Fellowship at RAND in health services research. He has conducted many grant-funded research projects in the area of access to and quality of health care for disadvantaged populations. This research has resulted in over 60 per-reviewed publications. Dr. Wood’s research interests are in the areas of measuring barriers to care, health literacy, adherence, health service utilization, and the transition of children with special health care needs to adult care.
Victoria Chau received her B.A. in Anthropology from the University of Florida and is a second year graduate student working on her Master of Public Health with a concentration in Social and Behavioral Sciences. She participated in AmeriCorps National Civilian Community Corps (NCCC) following her undergraduate education during which she spent 8 weeks participating in environmental conservation efforts throughout Northern and Southern Nevada. As an Asian-American woman of child-bearing age who has always lived near the coast, she is very aware of the potential dangers of mercury exposure due to her current research with the Duval County Health Department and UF CHEQR.

Ms. Chau worked as a research assistant in the pediatric hematology/oncology department at the University of Florida from January 2009 through December 2009, assisting in a Bone Marrow Transplant (BMT) national pilot study with the University of Florida and the National Marrow Donor Program (NMDP). Having a younger sister who is recently a BMT survivor, a mother who is the BMT donor, and a family full of BMT caregivers, the research experience has been invaluable to her both personally and professionally. Victoria’s public health interests include global health, health disparities, health communication, tobacco prevention and control, cancer prevention and control, obesity prevention, water and sanitation, and environmental health. Victoria hopes to one day work in Vietnam as a public health educator or in other developing nations as a public health educator.

University of North Carolina-Chapel Hill
Gillings School of Global Public Health
Faculty
Amy MacDonald, MS

Amy MacDonald is the Environmental Resource Program (ERP) Environmental Health Educator. She conducts outreach on childhood lead poisoning prevention, healthy homes and climate change. She serves as the statewide educator for the NC Childhood Lead Poisoning Prevention Program, and in this role, she provides technical assistance to local health departments, community-based and special interest organizations, professional groups and the public. Prior to joining ERP, Ms. MacDonald worked to create state-level policy to address global warming, and was selected to be one of 1,000 people in the US who are climate messengers as part of Al Gore’s “Climate Project.” She is a co-founder of the NC Climate Action Network, an intergenerational citizens group that works to connect people to policy action and climate solutions. Ms. MacDonald earned an MS in Environmental Policy and Behavior from the University of Michigan and a BS in Political Science and Environmental Studies from Central Michigan University.

Student
Lindsay Herendeen

Lindsay Herendeen received her BS in Environmental Science and Political Science from Allegheny College and is currently completing a joint MPH/MCRP degree program at the Gillings School of Global Public Health at University of North Carolina Chapel Hill. Ms. Herendeen worked for Allegheny College and managed the Healthy Homes—Healthy Children project during its transition into a comprehensive outreach program. As an AmeriCorps Volunteer, Lindsay worked for 11th Street Family Health Services of Drexel University, where she served as the Site Coordinator for a project aimed to provide environmental health outreach to low-socioeconomic status, inner-city pregnant women. During her time at University of North Carolina Chapel Hill, Lindsay seeks to combine her interests in childhood environmental public health, health behavior and health education, and city and regional planning. She plans to use her education to increase access to healthy housing and healthy communities through systems-level solutions.

Southeast Pediatric Environmental Health Specialty Unit Team

Emory University, Department of Pediatrics
PEHSU

Robert J. Geller, MD

Robert J. Geller, MD assumed the role of PEHSU Director in August 2005, after being a member of the PEHSU since its inception. He is a pediatrician and medical toxicologist. He is Professor of Pediatrics at Emory University School of Medicine, and has served as Medical Director of the Georgia Poison Center for 21 years. He currently is Secretary of the Board of Directors of the American Association of Poison Control Centers. He received his undergraduate and medical degrees from Boston University and his pediatrics training at Medical College of Virginia, and clinical toxicology training at the University of Virginia. His clinical activities are focused on children’s environmental health, toxicology, and asthma care.
Emory University, Rollins School of Public Health

I. Leslie Rubin, MD

Leslie Rubin MD is President and Founder of the Institute for the Study of Disadvantage and Disability, is Visiting Scholar in the Department of Pediatrics at Morehouse School of Medicine, Co-Director of the Southeast Pediatric Environmental Health Specialty Unit, Principal Investigator of the Healthy Tomorrows Partnership Project – Healthcare Without Walls, Medical Director of TEAM Centers in Chattanooga, Tennessee and Medical Director of the Adult Down Syndrome Program.

Dr. Rubin is originally from South Africa where he trained in Pediatrics and came to the USA to specialize in Neonatology and then in Developmental Pediatrics. He was initially at the Hospitals of the Case Western Reserve University in Cleveland Ohio from 1976-1980 and then The Children’s Hospital in Boston and the Harvard Medical School from 1980-1994. In July 1994 he moved to Atlanta, Georgia as Director of Developmental Pediatrics at Emory University and as Medical Director of the Marcus Institute.

He has been involved with the Southeast Pediatric Environmental Health Specialty Unit at Emory University since its inception, where he has integrated his understanding of Developmental Disabilities and applied this to populations of children who had been exposed to adverse environmental circumstances particularly in the city of Anniston, Alabama, where he helped form the Vision 2020, a citizens action group focused on promoting optimal health and development for the children of Anniston. In Chattanooga, Tennessee he was instrumental in the establishment of the Chattanooga Center for Autism Spectrum Conditions and in establishing a Developmental Pediatrics Program at the University of Tennessee-Chatt

In May 2004, he co-founded the Institute for the Study of Disadvantage and Disability, which is dedicated to improving awareness and understanding of the relationship between social and economic disadvantage and disabilities in children. The mission is accomplished by supporting and coordinating research including the Break The Cycle project which focuses on advanced university students addressing children living in situations of social and economic disadvantage. In September 2004 he left Emory University and Marcus Institute and joined the Morehouse School of Medicine. He is currently a member of numerous local, regional, national and international committees and projects that address the needs of children and adults with Developmental Disabilities.

Institute for the Study of Disadvantage and Disability

Janice T. Nodvin

Janice Nodvin has served as Project Administrator and Educator for the SE PEHSU since its beginning ten years ago. She is the Coordinator of the Break the Cycle Projects. Ms. Nodvin is the Program Director for the Institute for the Study of Disadvantage and Disability where she serves as Program Director for Project GRANDD (grandparents raising their grandchildren with disabilities and chronic illness), Program Coordinator for the Healthy Tomorrows Partnership Project – Healthcare Without Walls, and Clinic Director for the Adult Down Syndrome Program. Her role and expertise is in the areas of education, parent advocacy and program administration. She is the contact person for the SE PEHSU.

Morehouse School of Medicine, Department of Pediatrics

I. Leslie Rubin, MD

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**Overview of Break the Cycle**

**Break the Cycle** is a collaborative interdisciplinary research and training program with University faculty who mentored graduate students in academic tracks that focus on the environmental impact on children’s health. The target populations are communities where the environmental hazards are related to circumstances of social and economic disadvantage. Each student was required to develop a project that focuses on reducing or preventing environmental health related illnesses and disorders for children who live in these communities. Each student developed a creative project to “break the cycle” at any point.

**Environmental Health Disparities**

The diagram below represents the cycle of social and economic disadvantage as it is reflected in the physical and social environmental factors that can affect the health, growth and development of children and contribute to our societal challenge of *Environmental Health Disparities*. Ample evidence across a variety of academic and public policy domains supports the relationships and patterns depicted in the diagram. There is no question of the need to “**Break the Cycle**” at any level and thereby reduce the phenomenon of Environmental Health Disparities and promote good health and well-being for children and their families.

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**Cycle of Environmental Health Disparities**

- **Compounding Factors**
  - Limited Educational Services
  - Limited Health Care Services
  - Limited Social Capital

- **Health Risk Factors**
  - Physical
    - Asthma & Allergies
    - Neurotoxicity
    - Obesity & Hypertension
  - Emotional & Social
    - Depression
    - Substance Abuse
    - Violence

- **Personal Characteristics**
  - Limited Education
  - Limited Employment Options
  - Limited Empowerment
  - Limited Income

- **Residential Options**
  - Limited Choice
  - Limited Infrastructure
  - Limited Services

- **Residential Characteristics**
  - Older Houses in Disrepair
  - Adverse Environmental Factors
  - Adverse Social Factors

- **Impact**
  - Increase Toxins
  - Increase Stress
Presentations
Is Segregation Bad for Your Health?

Michael R. Kramer and Carol R. Hogue

Accepted for publication April 7, 2009.

For decades, racial residential segregation has been observed to vary with health outcomes for African Americans, although only recently has interest increased in the public health literature. Utilizing a systematic review of the health and social science literature, the authors consider the segregation–health association through the lens of 4 questions of interest to epidemiologists: How is segregation best measured? Is the segregation–health association socially or biologically plausible? What evidence is there of segregation–health associations? Is segregation a modifiable risk factor? Thirty-nine identified studies test an association between segregation and health outcomes. The health effects of segregation are relatively consistent, but complex. Isolation segregation is associated with poor pregnancy outcomes and increased mortality for blacks, but several studies report health-protective effects of living in clustered black neighborhoods net of social and economic isolation. The majority of reviewed studies are cross-sectional and use coarse measures of segregation. Future work should extend recent developments in measuring and conceptualizing segregation in a multilevel framework, build upon the findings and challenges in the neighborhood-effects literature, and utilize longitudinal data sources to illuminate opportunities for public health action to reduce racial disparities in disease.

demography; ethnic groups; health status disparities; public health; social isolation; socioeconomic factors; United States

INTRODUCTION

In 1950, Dr. Alfred Yankauer observed that the infant mortality rate for black babies and white babies in New York City increased as the concentration of blacks in the mother’s neighborhood of residence increased (1). While social scientists had been observing racial and ethnic residential settlement patterns for some time before this, Yankauer was the first to link racial residential segregation with population health. Only in the past 15 years has public health interest rekindled in considering whether segregation can explain longstanding racial and economic disparities in health, as evidenced by the growth in the number of publications in biomedical and social science journals (Figure 1).

David Williams has called segregation a “fundamental cause” of health disparities because of the manner in which it differentially sorts individuals into social and economic environments on the basis of race and class (2). Widespread health disparities in the United States remain difficult to explain (3, 4), and thus far difficult to ameliorate, making claims of a “fundamental cause” appealing. This review assesses the evidence for this claim by considering 4 broad questions of interest to epidemiologists: How is segregation best measured? Is the segregation–health association socially or biologically plausible? What evidence is there of segregation–health associations? Is segregation a modifiable risk factor?

With an eye toward these 4 areas of measurement, mechanism, association, and policy implications, we searched MEDLINE, CAHILL, EMBASE, ERIC, PsycINFO, and the Web of Science databases in September 2008 using variants of the term “residential” combined with variants of the term “segregation,” resulting in 2,564 citations. Important literature exists (and more is needed) to enable understanding of economic segregation, segregation of Hispanics and Asians, and the role of segregation in rural areas, but these topics were not the subject of this literature review. The largest body of literature concerns health and the residential segregation of blacks and whites in metropolitan areas of the United States; we therefore focused primarily on these studies and reports. A brief review of the history of black-white segregation in the United States precedes attention to the 4 questions structuring this paper.

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HISTORY OF SEGREGATION IN THE UNITED STATES

Residential segregation is the degree to which groups of people categorized on a variety of scales (race, ethnicity, income) occupy different space within urban areas, and the process that creates this differential spatial distribution (5). Segregation in US cities is neither new nor unique to any one ethnic or racial group. New European immigrants to US urban areas frequently resided in relatively homogenous ethnic enclaves, a process that may be a critical component of assimilation (6). This segregation of new immigrants typically subsides within a generation as economic opportunity and upward mobility lead to fuller integration. Yet, for black Americans, segregation increased throughout much of the 20th century.

Cutler et al. (7) portray black-white residential segregation in the 20th century in 3 distinct periods. The first, the birth of the ghetto, spanned from 1890 to 1940 (Cutler et al. distinguish “ghetto” as a largely black, segregated area, as opposed to a slum, which denotes quality of living conditions). Large-scale migration of rural southern blacks to urban areas in the Northeast was driven by changes in agricultural practices in the South and demand for manual labor in the industrial North. While the average urban black in 1890 lived in a neighborhood that was 27% black, by 1940 this black percentage had increased to 43% (7). This period of increasing racial density parallels the pattern of any new immigrant group and results largely from an affinity of newcomers to live near other newcomers. Congregating in neighborhoods offered opportunity for job leads, connections to cultural and religious institutions, and social support. Limited evidence of housing markets during this period suggests this early segregation may have been driven as much by black choice as by structured limitation to other options.

The period from 1940 to 1970 was one of consolidation and expansion of the urban black ghetto. While further migration of rural blacks into southern and northern urban areas continued to expand the size of the black population in many cities, racial tensions were increasing (8). In a process Cutler et al. call collective action racism, housing markets were manipulated by law, restrictive covenant, and overt acts of intimidation by whites to maintain and increase separation. According to one estimate, 80% of housing deeds in some areas included restrictive covenants regarding race (7, 9). Massey and Denton (10) argue that it was this period of sanctioned and institutionalized racism, which they likened to South-African apartheid, that formed the segregation that persists to today. By most measures, black-white residential segregation peaked in 1970, when the average urban black person lived in a neighborhood that was 68% black (7).

Since 1970, segregation has decreased modestly. This trend resulted mostly from the movement of some black families to previously all-white areas rather than from the integration of largely black areas. While segregation may have decreased overall, the results of previous decades have persisted in terms of isolation and poverty concentration for many urban black residents. There are some areas (particularly in the South and West) in which middle-class black families have integrated into white neighborhoods, while poor black families have become increasingly isolated physically and economically in areas that suffer from infrastructure disinvestment (11).

The Civil Rights Act (Fair Housing Act) of 1968 prohibited discrimination in housing sales and rentals and thus theoretically stopped the collective-action racism that shaped segregation during the preceding decades. Nevertheless, ongoing financial and interview audit studies demonstrate that redlining (the illegal process of systematically denying loans to certain portions of a city) and outright racial discrimination persist today in shaping urban housing markets (12). Cutler et al. (7) argue that, in this third historical period from 1970 forward, decentralized racism became the operative process maintaining segregation.
During this phase, white avoidance (due to racism or to escape from economically crumbling central cities) may be most operative in maintaining segregation, as evidenced by whites paying more for comparable housing in predominantly white neighborhoods and survey data that blacks more than whites desire greater residential integration (64% of blacks vs. 40% of whites in 2007) (13).

This brief review of the history of 20th-century segregation in the United States points out 2 important features relevant to the health researcher. First, the black-white urban residential segregation seen today is distinct from any other ethnic or group segregation in the United States, and perhaps elsewhere in the world, and therefore reflects a process of social stratification that is both historically and uniquely American. Second, because the mechanisms driving segregation varied over time, the health implications of segregation may vary temporally as well. For example, the health effects associated with the early 20th century ethnic enclaves of new black immigrants to the North were likely different from those experienced by residents of the hyper-segregated cities in the latter 3 decades of the 20th century, where poverty concentration and infrastructure decay dominate.

MEASURING RESIDENTIAL SEGREGATION

The nonrandom clustering of social groups in space is not inherently good or bad. To affect population health, segregation must have more to it than the departure from random distribution of housing, and yet it is precisely this patterning of residents that is typically measured in segregation indices. One challenge in conceptualizing segregation is that its social and health-relevant effects are often described in terms of the process of segregation—a series of forces that differentially allot individuals into residential environments and economic opportunities on the basis of race (10, 14)—as opposed to the condition or state of segregation, which is the description of spatial residential patterns at a point in time (15). Many studies essentially estimate the degree to which measuring the state approximates what we believe the process to be.

The crudest measure of segregation (used by Yankauer (1) in 1950, and by many investigators currently) is the proportion of a group (e.g., whites) in a given neighborhood (e.g., census tract), often termed neighborhood racial composition. It is easily operationalized and appears intuitive to the reader, but it says nothing about the distribution of people in space, is invariant to population density in a neighborhood, and does not specify a reference against which to measure the neighborhood (e.g., a neighborhood that is 30% black means different things in a city that is 1% black and one that is 30% black). In other words, the composition of a given neighborhood is independent of the residential patterning of the larger city.

For these reasons, most social scientists utilize measures that acknowledge 2 scales of geography: subareas (e.g., neighborhoods) situated within larger overall geographic areas (e.g., cities or metropolitan areas). Segregation is then expressed as a comparison of the subareas to the overall area, commonly in the form of a population-weighted aver-
One interesting result of eliminating the arbitrary reliance on census tracts as the default scale of neighborhoods is that the 5 dimensions of segregation collapse into 2 (18, 21). Reardon (21) argues that the distinction between evenness and neighborhood clustering is simply a matter of the scale at which measures are calculated. Similarly, centralization and concentration can be seen as special cases of the general spectrum of evenness versus clustering of households, which results in spatial evenness and spatial isolation as 2 general dimensions of residential segregation. Few studies have utilized a spatial measure of segregation (28, 29), and it remains to be seen whether these measures will prove to be meaningfully different tools for understanding the association between segregation and health.

Although most studies identified used segregation measures for 2 groups, indices do exist for alternate conceptualizations. With increasingly multicultural cities, researchers' interest may lie in the residential patterns of multiple racial and ethnic groups simultaneously or the black-white patterns in the context of other groups (30). Multigroup segregation indices are logical extensions of the 2-group indices mentioned above (31, 32). Segregation can also be measured along an ordinal scale, as would be the case for understanding segregation across levels of family income (33, 34).

**POTENTIAL SOCIAL/BIOLOGIC PATHWAYS FROM SEGREGATION TO POPULATION HEALTH**

A primary concern of epidemiologists regarding any exposure-disease relation is its biologic (or social) plausibility: through what causal pathway could an association be mediated? Four interconnected mechanisms (Figure 2) are commonly hypothesized: 1) residential segregation begets individual socioeconomic status, which itself is related to health; 2) segregation perpetuates and reproduces unhealthy neighborhood environments; 3) segregation modifies social capital for a city overall or for specific racial groups within a city; and 4) segregation modifies individual risk behaviors or exposure to stressful stimuli (2, 35-37). Segregation is often construed to affect minority communities differently from majority communities, and, as such, these mechanisms relate to possible mechanisms for varying racial disparities in health. Evidence for each mechanism is reviewed in turn below.

**Segregation and individual socioeconomic status**

A leading hypothesis is that the toxic effects of residential segregation are due in part to the association of racial segregation with economically related consequences (11). Strong evidence exists for an interaction of racial and economic segregation through spatial concentration of minority poor people in urban areas. The majority of poor people in the United States are white, yet most poor whites live in economically integrated neighborhoods. In contrast, most poor blacks live in poor neighborhoods (38). The propensity for poor blacks to live in high-poverty neighborhoods has been termed “double jeopardy” (39). In the United States in 2000, 1.4% of white children lived in poor families inside poor neighborhoods, while 16.8% of black children experienced this double jeopardy. The average black child spends 50% of his or her first 18 years of life in high-poverty neighborhoods, while the average white child spends 5% (40).

One of the most direct consequences of this spatial concentration of the poor is reduced educational opportunities,
because school options are primarily a function of neighborhood of residence. If all schools were equal, this issue would be inconsequential, yet there is substantial evidence that poor urban schools perform worse than suburban schools on nearly all markers of quality, including curricular variety, test scores, teacher and administrator experience, high school completion, and the social environment including violence, drugs, and teen pregnancy (2, 41, 42). In a study on the racial gap in Scholastic Aptitude Test (SAT) scores, metropolitan-level segregation explained one quarter of the gap (approximately 45 points) (43). Growing up in more-compared with less-segregated neighborhoods negatively affects adult educational attainment (44) and may influence the academic performance of those who enter college (45).

One approach to estimating the causal component of segregation on the education gap is to use an instrumental variable analysis, in which a variable causally associated with segregation, but unlikely to be associated with education, is substituted in models. Cutler and Glaeser (46) used number of rivers in a metropolitan area as an instrumental variable for segregation, acknowledging the likely causal manner in which topographic features such as rivers reduce intracity migration and increase segregation. They found that segregation measured with the dissimilarity index was negatively associated with adults having obtained high school and college degrees, and that the pattern of association held when segregation was instrumented by rivers.

Segregation also reduces employment opportunities and lowers income through a spatial mismatch of workers and jobs. When education and skills are controlled for, black residents in highly segregated cities are more likely to be unemployed than black persons living in less-segregated cities (47) and to spend more time searching for jobs (48), and they are less likely to be self-employed (11, 49, 50). These effects are particularly strong for extremes of the isolation and clustering dimensions. A review of urban employment and industry over 40 years concluded that the degree of spatial mismatch was less explanatory of racial disparities in employment than was the overall decrease in urban manufacturing (51). However, another study testing the spatial mismatch theory used employment records of the US Postal Service, which, as an institution, has had large processing facilities geographically fixed in urban centers throughout the post–World War II decades (52). In this analysis, degree of metropolitan segregation was unassociated with racial composition of the US Postal Service workforce in the 1940s–1960s. When centrally located urban jobs declined with the exodus of manufacturing in the 1970s, the degree of city segregation and black employment at central postal facilities became correlated, suggesting that racial segregation in the past 30 years is associated with decreased access to employment opportunity for many black families.

While poor blacks disproportionately experience the negative effects of segregation (53), middle-class blacks may also suffer from residential segregation through limited housing choices (54, 55), limited wealth accumulation (56), and restrictions on upward mobility (57). Middle-class blacks are more likely than poor blacks to live in less-segregated neighborhoods, yet they often do not achieve income-matched parity with whites in terms of neighborhood quality, with blacks living in neighborhoods that are older and have lower tax bases, and living among whites who have a lower mean income than they do (58). In fact, for blacks (compared with Hispanics or Asians), degree of residential segregation is relatively independent of individual socioeconomic status (59).

**Segregation and neighborhood socioeconomic environment**

Although segregation may limit individuals' economic opportunities, it could also produce neighborhoods that are in and of themselves unhealthy. This hypothesized pathway links the segregation health literature with the increasingly rich neighborhood effects–health literature in a manner that may complement each. In recent years, a large body of research has struggled to distinguish between the population health impacts of neighborhood context versus neighborhood composition (60–62). One important criticism of this literature is the limited ability to account for selection into neighborhoods, a plausible confounder of the contextual-health association (63). However, metropolitan-level segregation may serve as one such distal sorting mechanism that accounts for the differential assignment of neighborhood environment.

Segregation may propagate negative social environments in multiple ways. Highly segregated cities suffer from higher levels of violent and property crime (64–66). This association seems particularly true for cities with high income inequality, poverty concentration, and segregation on the isolation dimension, suggesting that social isolation and corresponding economic inequality may be particularly important in this regard (65, 67, 68). Neighborhood health is thereby worsened, not only by risk of victimization but also by alterations to individual behavior and social networks associated with living in a dangerous environment (69, 70). Finally, a combination of increased crime and systematic differences in policing and arrests results in high male incarceration rates in many segregated black urban communities (71, 72). This large-scale incarceration of young black men affects the health of the men but has also been implicated in destabilizing family support systems, thereby impacting the health of women and children (73, 74).

Both isolation and concentration probably enhance the spread of infectious disease such as tuberculosis (75, 76), human immunodeficiency virus (77), and gonorrhea (78) and possibly lead to racially disparate exposure to environmental toxins. There is conflicting evidence on differential toxic exposure, with 2 studies suggesting an increased health risk for poor and minority communities from toxin releases in highly segregated cities (79–81) but 1 study observing racial differences in exposure to toxic hazards that were not explainable by degree of segregation (82).

Also of concern is differential access to local health-relevant resources. Segregated and poor neighborhoods tend to have fewer options for purchasing healthy food and more options for purchasing alcohol (83–87). Simply residing in economically deprived neighborhoods may also be associated with important health outcomes such as obesity and heart disease (88–90). There is mixed evidence regarding whether Medicaid
Segregation and social capital

Social capital has been defined as the degree of social trust, extent of social networks, and willingness to provide mutual aid and reciprocity between individuals in a given area (95, 96). Kawachi (97) and others have proposed that variations in social capital may explain geographic variations in population health, with a relative health-protective effect of living in a social-capital-rich area. Although Putnam (95) suggests that increased social capital is associated with increased equality, it has been argued that the social capital in a given area does not necessarily cross race or class lines and in some cases may be inversely associated with indicators of racial equity (98).

Whether degree of metropolitan segregation increases or decreases social capital is unclear. There is some evidence that high-isolation segregation and concomitant poverty concentration decrease black social capital and reduce inter-racial trust (99–101). However, a body of evidence also suggests health-protective effects for blacks who live in racially homogenous ethnic enclaves, a phenomenon attributed to enhanced social support and ties. For example, Bell et al. (102) found that isolation segregation increases risk of low-birth-weight infants but that, when conditioning on isolation, higher clustering segregation reduces risk of low birth weight. It is posited that, given the adverse environment posed by isolation segregation, increased clustering may provide social support and enhance political power for black communities. Laveist (103, 104) suggests that the black political empowerment that sometimes results from high-clustering segregation can counter the negative effects of segregation on health outcomes.

Segregation and individual behaviors and exposures

It is also plausible that some effect of segregation on health could be mediated through individual-level behaviors and exposures patterned by the socioeconomic and neighborhood environmental effects previously described. While much research has looked at individual behaviors to understand racial disparities in health generally, relatively few studies have considered individual behaviors as mediating variables between segregation and health. Increasing residential segregation is associated with eating less fruit (105) and being less physically active (106). For black women, living in neighborhoods with either relatively low or relatively high segregation has been associated with increased smoking during pregnancy (107). Black women typically smoke less than whites during pregnancy (108), and the authors attribute the increased smoking to influence of the majority group in the integrated neighborhoods and response to stressors in the segregated neighborhoods. A different category of individual exposure now receiving increased attention is the role of psychosocial stress (109–111)—including adverse life events and perceived racism (112)—in chronically “weathering” immune and neuroendocrine systems, thereby increasing susceptibility to disease (113, 114). Whereas segregation can be seen as a form of institutionalized racism (115), it may interact with personally mediated racism or discrimination, thus representing a truly individual-level exposure. This hypothesis has perhaps been most widely tested in understanding determinants of pregnancy outcomes, in which increased segregation and perceived racism have been found to increase risk for black women (102, 116, 117).

Refining causal pathways through the lens of the dimensions of segregation

Each of the 5 dimensions of segregation described by Massey and Denton (5) serves as a proxy for overlapping, but distinct types of residential patterning. To the degree that the dimensions diverge, health researchers have an opportunity to test more refined causal hypotheses for the effects of segregation on health. Going hand in hand with this notion is the expectation that researchers clearly describe hypothesized causal path by which the effects may be mediated. Different health outcomes are sensitive to different mechanisms; thus, the dimension of segregation that is most relevant is likely to vary by outcome of interest.

For example, Acevedo-Garcia (16) suggests that segregation on the concentration and isolation dimensions may be conducive to the spread of infectious diseases, whereas Dickerson (47) reports that clustering and evenness are most predictive of the degree of black unemployment. Either unevenness or the contiguous clustering of predominantly black neighborhoods could similarly associate with these negative exposures; however, conditional on degree of isolation, they may represent the ethnic enclave effect, which provides social support and increases relative political power (103, 118). As previously discussed, this possibly protective effect of one kind of segregation, conditioning on others, suggests a richer complexity that can be leveraged in hypothesizing causal pathways. One other pattern deserving of attention is the hypersegregated area, where segregation is deemed high on all 5 dimensions, possibly incurring a unique health effect not seen in cities considered high regarding only some dimensions (119, 120).

SEGREGATION-HEALTH ASSOCIATIONS

We identified 39 studies that used quantitative approaches to measuring an association between racial segregation and a health outcome (Table 1). The vast majority demonstrated statistically significant observed associations, although the evidence for a causal association is limited by study designs. Seventeen studies (most conducted before 2000) were cross-sectional ecologic (1, 75, 78, 103, 112, 121–132), 16 studies were cross-sectional multilevel (accounting for various individual-level covariates while acknowledging segregation as an inherently contextual variable) (28, 29, 37, 69, 102, 120, 133–142), 5 utilized follow-up data collected either prospectively or retrospectively (143–147), and 1 utilized a time-series, cross-sectional ecologic design (148). In terms of health outcomes, the majority of the earlier studies
Table 1. Population Studies of Racial Residential Segregation and Health, United States

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<tr>
<th>Author, Year (Reference No.)</th>
<th>Study Design (Population)</th>
<th>Measure of Segregation (Geographic Unit (Neighborhood Unit))</th>
<th>Outcome</th>
<th>Results</th>
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<tbody>
<tr>
<td><strong>Mortality studies</strong></td>
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<tr>
<td>Hearst, 2008 (142)</td>
<td>Cross-sectional, multilevel (infants born to black mothers in 64 central cities with ≥200,000 population)</td>
<td>Isolation dichotomized at 0.6 into “segregated” or “not segregated” (central city/census tract)</td>
<td>Infant mortality</td>
<td>propensity score matched analysis demonstrated no significant infant mortality rate difference in segregated vs. nonsegregated cities</td>
</tr>
<tr>
<td>Inagami, 2006 (121)</td>
<td>Cross-sectional, ecologic (black, white, and Hispanic adults in New York City, 1989–2001)</td>
<td>“Black areas” (≥70% black), “white areas” (≥75% white); “Hispanic areas” (≥70% Hispanic) (New York City zip code areas)</td>
<td>All-cause mortality</td>
<td>Mortality lowest for blacks, whites, and Hispanics living in neighborhoods of the same ethnicity</td>
</tr>
<tr>
<td>Laveist, 2003 (143)</td>
<td>Prospective cohort (National Survey of Black Americans respondents enrolled in 1979–1980)</td>
<td>Multidimensional segregation index compiled from self-reported segregation in school, work, residence, and church</td>
<td>Survival over 13 years of follow-up</td>
<td>Segregation in 3-level mortality model with increasing segregation-related mortality; adjusted HR = 1.2 (95% CI 1.02, 1.41) for 1-unit change in segregation index</td>
</tr>
<tr>
<td>Cooper, 2001 (122)</td>
<td>Cross-sectional, ecologic (white adults and black adults in 257 MSAs, 1989–1991)</td>
<td>Dissimilarity (metropolitan area/census tract)</td>
<td>Premature mortality (prior to age 65 years)</td>
<td>Increasing dissimilarity associated with premature mortality</td>
</tr>
<tr>
<td>Jackson, 2000 (144)</td>
<td>Retrospective cohort (National Longitudinal Mortality Study, enrolled in 1978–1985)</td>
<td>% Black in 1980 in census tract of residence at enrollment</td>
<td>All-cause mortality</td>
<td>2- to 3-fold increased mortality rate for blacks aged 25–44 years living in predominantly black neighborhoods compared with &lt;10% black neighborhoods; associations modest to null for older blacks and for whites</td>
</tr>
<tr>
<td>Collins, 1999 (112)</td>
<td>Cross-sectional, ecologic (black adults and white adults in cities with &gt;100,000 total population and &gt;10% black, 1990)</td>
<td>Isolation and dissimilarity (metropolitan area/census block group)</td>
<td>Age-adjusted all-cause, leading cause, and homicide mortality</td>
<td>Isolation associated with increased all-cause, cancer, and heart disease mortality in blacks; associated with higher cancer mortality in white males</td>
</tr>
<tr>
<td>Fang, 1998 (123)</td>
<td>Cross-sectional, ecologic (non-Hispanic black adults and white adults, New York City, 1988–1994)</td>
<td>“Black areas” (≥75% black), “white areas” (≥75% white) (New York City zip code areas)</td>
<td>All-cause and cause-specific mortality</td>
<td>Higher mortality for older blacks living in predominantly black areas; higher mortality for whites living in predominantly black areas; lower mortality for blacks living in predominantly black areas</td>
</tr>
<tr>
<td>Hart, 1998 (125)</td>
<td>Cross-sectional, ecologic (black adults and white adults aged 25–64 years in 124 MSAs with &gt;200,000 population, 1990–1991)</td>
<td>Dissimilarity (metropolitan area/census tract)</td>
<td>Metropolitan age- and race-adjusted mortality rates</td>
<td>Higher dissimilarity associated with higher black mortality for males and females, but no association for whites</td>
</tr>
<tr>
<td>LeQuere, 1997 (145)</td>
<td>Prospective cohort (National Health Interview Survey respondents, 1986–1990)</td>
<td>% Black in census tract</td>
<td>Survival over follow-up (maximum 8 years of follow-up)</td>
<td>Increasing concentration of blacks in census tract associated with lower survival for whites and blacks, with moderate dose response</td>
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Table continues
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<thead>
<tr>
<th>Author, Year (Reference No.)</th>
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</thead>
<tbody>
<tr>
<td>Polednak, 1996 (148)</td>
<td>Time-series, ecologic (black births and white births in 38 MSAs with &gt;1 million population, 1982–1991)</td>
<td>Dissimilarity with MSAs divided into quintiles of segregation (metropolitan area (census tract))</td>
<td>Yearly black infant and white infant mortality rates for 1982–1991</td>
<td>For the highest quintile of segregated cities: higher than average black infant mortality for every year; for the lowest quintile: lower black infant mortality for 1982–1986, but similar black infant mortality risk between the lowest and highest quintiles in 1988–1991; no effect for whites</td>
</tr>
<tr>
<td>Lavalat, 1993 (103)</td>
<td>Cross-sectional, ecologic (births to black women and white women in MSAs with &gt;50,000 population and &gt;10% black, 1981–1985)</td>
<td>Dissimilarity (metropolitan area (census tract))</td>
<td>Black-white disparity (risk ratio) for infant mortality for each city</td>
<td>Increase in the black-white gap as dissimilarity increases</td>
</tr>
<tr>
<td>Polednak, 1992 (127)</td>
<td>Cross-sectional, ecologic (black adults and white adults in 36 MSAs with &gt;1 million population, 1982–1986)</td>
<td>Dissimilarity (metropolitan area (census tract))</td>
<td>Black-white adult mortality risk difference</td>
<td>Increasing dissimilarity associated with increasing black-white mortality gap</td>
</tr>
<tr>
<td>Polednak, 1981 (129)</td>
<td>Cross-sectional, ecologic (black births and white births in 38 MSAs with &gt;1 million population, 1982–1986)</td>
<td>Dissimilarity (metropolitan area (census tract))</td>
<td>Black-white infant mortality risk difference</td>
<td>Increasing dissimilarity associated with larger difference between black infant and white infant mortality</td>
</tr>
<tr>
<td>Yarkauer, 1950 (1)</td>
<td>Cross-sectional, ecologic (black women and white women delivering in New York City, 1945–1947)</td>
<td>% Black in 318 “residential areas” of New York City</td>
<td>Infant mortality</td>
<td>Increase in black infant and white infant mortality as proportion black in neighborhood of residence increased</td>
</tr>
<tr>
<td>Kramer, 2008 (129)</td>
<td>Cross-sectional, ecologic (black women and white women with live births in 168 MSAs, 2002–2004)</td>
<td>Isolation and dissimilarity (metropolitan area (census tract))</td>
<td>Very preterm birth (&lt;32 weeks)</td>
<td>Increased risk of very preterm birth with isolation but decreased risk with unevenness for black women; no effect for white women</td>
</tr>
<tr>
<td>Osypuk, 2008 (120)</td>
<td>Cross-sectional, multilevel (black women and white women delivering live births in 237 MSAs, 2000)</td>
<td>Hypersegregation defined as highly segregated on ≥2 of 5 dimensions (metropolitan area (census tract))</td>
<td>Preterm birth (&lt;37 weeks)</td>
<td>Increased odds of preterm birth to black women in hypersegregated cities compared with not; black-white disparities also larger in hypersegregated cities</td>
</tr>
<tr>
<td>Vinkoor, 2006 (134)</td>
<td>Cross-sectional, multilevel (black women delivering live births in Wake and Durham Counties, North Carolina, 1999–2001)</td>
<td>Predominantly black census tracts (&gt;75%) vs. mixed census tracts (&lt;75%)</td>
<td>Low birth weight (&lt;2,500 g); preterm birth (&lt;37 weeks)</td>
<td>Income inequality (living in a higher median income tract than expected based on individual education and marital status) protective against low birth weight and preterm birth in predominantly black neighborhoods but not in mixed tracts</td>
</tr>
<tr>
<td>Grady, 2007 (28)</td>
<td>Cross-sectional, multilevel (foreign and US-born black women delivering live births in New York City, 2000)</td>
<td>Local spatial segregation index (New York City (census tract))</td>
<td>Low birth weight (&lt;2,500 g)</td>
<td>Increased isolation associated with increased low birth weight risk for US-born black women after control for individual and neighborhood poverty; for foreign-born woman, excess risk explained by individual risk factors</td>
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Table 1. Continued

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<tr>
<td>Masi, 2007 (135)</td>
<td>Cross-sectional, multilevel (black, white, and Hispanic women delivering live singleton births in Chicago, Illinois, in 1991)</td>
<td>Census tracts categorized as &lt;10% black, 10%-90% black, &gt;90% black</td>
<td>Birth weight (continuous); preterm birth (&lt;37 weeks)</td>
<td>No association of racial concentration on birth weight or preterm birth for black women; modest association for white women, with higher risk in predominantly black tracts</td>
</tr>
<tr>
<td>Bell, 2006 (12)</td>
<td>Cross-sectional, multilevel (livebirths to black women in 225 US MSAs, 2002)</td>
<td>Isolation and spatial proximity (metropolitan area (census tract))</td>
<td>Birth weight (continuous); preterm birth (&lt;37 weeks); intrapartum growth restriction</td>
<td>Decreased birth weight (68 g) and increased preterm birth for high vs. very low isolation (OR = 1.27; high vs. very low clustering associated with higher birth weight (25 g) and lower preterm birth (OR = 0.86)</td>
</tr>
<tr>
<td>Grady, 2006 (28)</td>
<td>Cross-sectional, multilevel (black women with livebirths in New York City, 2000)</td>
<td>Local spatial segregation index (New York City (census tract))</td>
<td>Low birth weight (&lt;2,500 g)</td>
<td>Segregation associated with low birth weight independent of neighborhood poverty and individual SES</td>
</tr>
<tr>
<td>Pickett, 2006 (37)</td>
<td>Cross-sectional, multilevel (black women delivering livebirths in Chicago, Illinois, 1991)</td>
<td>Predominantly black census tracts (&gt;90%) vs. mixed census tracts (&lt;90%)</td>
<td>Low birth weight (&lt;2,500 g); preterm birth (&lt;37 weeks)</td>
<td>Income inequality (living in a higher median income tract than expected based on individual education and marital status) protective against low birth weight and preterm birth in predominantly black neighborhoods, but not in mixed tracts</td>
</tr>
<tr>
<td>Ellen, 2000 (136)</td>
<td>Cross-sectional, multilevel (black women and white women delivering livebirths in 261 MSAs with &gt;100,000 population and &gt;5,000 black, 1980)</td>
<td>Disparity and centralization (metropolitan area (census tract))</td>
<td>Low birth weight (&lt;2,500 g)</td>
<td>Increasing segregation associated with increased risk of low birth weight for black women but not white women</td>
</tr>
<tr>
<td>Sucot, 1998 (146)</td>
<td>Retrospective cohort (black female Panel Study of Income Dynamics participants born in 1953–1966)</td>
<td>Neighborhoods (tracts) categorized by racial concentration</td>
<td>Time to teenage premartial first birth</td>
<td>Black girls in highly segregated neighborhoods 50% more likely than black girls in racially mixed tracts to have premartial births before age 20 years</td>
</tr>
</tbody>
</table>

**Other health outcomes**

- Haas, 2006 (133)
  - Cross-sectional, multilevel (black, white, and Hispanic adults aged >65 years in the SEER database, 1992-2002)
  - Isolation (counties (census tract)); categorized into high vs. low-segregated counties
  - Early- vs. late-stage diagnosis of primary lung, colorectal, breast, or prostate cancer
  - Black-white disparity in early-stage diagnosis
  - Isolation in high-segregation, low-income neighborhoods

- Cooper, 2007 (130)
  - Cross-sectional, ecologic (black in MSAs with >500,000 population in 1990)
  - Isolation and concentration (metropolitan area (census tract))
  - Injection drug use prevalence
  - Isolation, but not concentration, associated with black injection drug use prevalence

- Do, 2007 (137)
  - Cross-sectional, multilevel (NHANES III participants, 1988-1994)
  - % Black or % Hispanic (census tract)
  - Body mass index
  - Proportion black and Hispanic in a neighborhood
  - Marginally associated with body mass index in black and Hispanic males but not females

- Rodriguez, 2007 (147)
  - Retrospective cohort (black adults and white adults beginning dialysis between 1985 and 2002)
  - % Black in patient zip code area divided into quartiles
  - Time to death or kidney transplant
  - Increased mortality for whites but not blacks as black concentration increases; time to transplantation longer for both blacks and whites living in predominantly black neighborhoods

Table continues

Table 1. Continued

<table>
<thead>
<tr>
<th>Author, Year (Reference No.)</th>
<th>Study Design (Population)</th>
<th>Measure of Segregation (Geographic Unit)*</th>
<th>Outcome</th>
<th>Results</th>
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</thead>
<tbody>
<tr>
<td>Chang, 2006 (136)</td>
<td>Cross-sectional, multilevel (black respondents and white respondents to BRFSS, 2006)</td>
<td>Isolation index (metropolitan area)</td>
<td>Body mass index (continuous) % with body mass index ≥30 kg/m²</td>
<td>One standard deviation increase in isolation associated with a 0.42 increase in body mass index, and obesity OR = 1.14 for blacks, no association for whites</td>
</tr>
<tr>
<td>Mooly, 2006 (69)</td>
<td>Cross-sectional, multilevel (unmarried, low-income women enrolled from 5 US states)</td>
<td>Isolation index; although scale of neighborhood and broader area not defined</td>
<td>Body mass index 10-year predicted heart disease risk</td>
<td>No association between segregation and body mass index for any group, and reduced coronary heart disease risk for blacks and Hispanics as segregation increased</td>
</tr>
<tr>
<td>White, 2006 (140)</td>
<td>Cross-sectional, multilevel (adults in New York City Social Indicator Survey, 1999–2002)</td>
<td>% Minority by zip code area, categorized into families</td>
<td>Self-rated health fair/poor vs. excellent/very good/good</td>
<td>Poor self-rated health associated with higher density minority in zip code area (aOR = 1.7, 66% CI: 1.1, 2.7)</td>
</tr>
<tr>
<td>Subramanian, 2005 (141)</td>
<td>Cross-sectional, multilevel (black adults and white adults living in MSAs with &gt;100,000 population and &gt;6,000 black, 2000)</td>
<td>Disparity and isolation (metropolitan area)</td>
<td>Self-rated health fair/poor vs. excellent/very good/good</td>
<td>High isolation associated with increased odds of poor self-rated health among blacks but not whites</td>
</tr>
<tr>
<td>Skinner, 2003 (132)</td>
<td>Cross-sectional, ecologic (black beneficiaries and white beneficiaries of Medicare, 1998–2000)</td>
<td>Disparity (metropolitan area)</td>
<td>Rates of knee arthroplasty</td>
<td>Smaller difference in black and white knee arthroplasty for women living in low-segregation cities (rate difference = 0.46/1,000) vs. high-segregation cities (rate difference = 1.05/1,000); no effect for men</td>
</tr>
<tr>
<td>Thomas, 2003 (75)</td>
<td>Cross-sectional, ecologic (counties in 14 southeastern US states, 1996–1998)</td>
<td>Disparity and isolation (counties)</td>
<td>County gonorrhea rates categorized as endemically high or endemically low</td>
<td>Black isolation index &gt;0.2 associated with endemically high counties controlling for proportion black and poverty indicators (aOR = 2.48, 95% CI: 2.2, 2.78)</td>
</tr>
<tr>
<td>Acevedo-Garcia, 2001 (75)</td>
<td>Cross-sectional, ecologic (New Jersey adults)</td>
<td>Isolation and concentration (New Jersey zip code area)</td>
<td>Annual incidence of tuberculosis by race</td>
<td>Higher isolation associated with tuberculosis in blacks and, to a lesser extent, Hispanics; no association for whites</td>
</tr>
</tbody>
</table>

Abbreviations: aOR, adjusted odds ratio; BRFSS, Behavioral Risk Factor Surveillance System; CI, confidence interval; HR, hazard ratio; MSA, Metropolitan Statistical Area; NHANES, National Health and Nutrition Examination Survey; OR, odds ratio; SEER, Surveillance, Epidemiology, and End Results.

* Geographic units for measuring segregation are displayed in terms of the nesting of 2 scales: (macro area (neighborhood subarea)).

focused on infant and adult mortality, while studies of the past decade broadened to include a wide variety of reproductive, infectious, and chronic disease endpoints.

A third of the studies conducted in the past decade relied on racial composition of neighborhoods to define segregation rather than indices that place those neighborhood compositions in the context of the wider city. As previously noted, the proportion of blacks in a neighborhood is an incomplete description of residential patterns, although several studies used custom-defined thresholds of proportion black to describe “predominantly black” and “predominantly white” neighborhoods (37, 121, 123, 134).
frequently cited. The 1976 court decree establishing the Gautreaux Assisted Housing Program in Chicago, Illinois, was in response to a preceding housing discrimination lawsuit against the Chicago Housing Authority claiming systematic discrimination in public housing. The Gautreaux program represents a natural experiment wherein 7,000 housing vouchers were made available to residents of highly segregated Chicago neighborhoods with the requirement that recipients be placed in racially integrated, low- to moderate-poverty neighborhoods (152). Subsequent studies of the placement cohort found that, 10–20 years later, the majority continued to live in lower poverty, less-segregated neighborhoods than prior to placement (153); second-generation boys placed in the suburbs had fewer drug offenses (154); and, among males relocating to areas with higher proportions of college graduates, all-cause and homicide-related mortality was lower (155).

In the federally funded, randomized Moving To Opportunity (MTO) trial, public-housing-eligible families were assigned either housing counseling with a voucher requiring placement in a low-poverty neighborhood, a voucher without geographic restriction, or no voucher (156). While early evidence supported positive economic effects for treatment families (157), those gains may not persist with time (158, 159). In terms of health outcomes, there is some evidence that families that moved to low-poverty neighborhoods experienced significantly improved mental health (160) and lower obesity rates (161), but other health outcomes such as asthma and self-reported health were not different from those of controls.

In separate reviews of housing-mobility programs and health effects, Acevedo-Garcia et al. (162) and Anderson et al. (45) suggest that there is modest support for rental voucher programs as one approach to improve housing safety, reduce risk of crime victimization, and improve adult and child mental health. The paucity of evidence for other outcomes is in large part due to the absence of health outcomes as originally measured indicators in either study.

Research that continues to pursue the effects of public housing policy interventions on population health is important. Another approach is to view the causal chain from segregation to health as a series of opportunities for intervention, with an overarching goal of increasing access to “opportunity neighborhoods” for all (39). This option opens up opportunities to alter negative effects of segregation that could range from assisting in opening housing markets so that moves out of concentrated poverty are possible (45, 153, 162) to addressing characteristics of segregated neighborhoods that are unhealthy, as seen in the built-environment literature (163, 164). One caution, however, is that researchers seeking to remedy the effects of segregation remain cognizant of the distinction between the process of segregation (e.g., institutionalized racism or inequitable access to health-promoting opportunities) and the state or condition of segregation (living near black families or far from white families) (115). It is most probable that any injurious attributes of segregation result from inequity in the process rather than the condition of close proximity to black families (or distance from white families) per se.
DISCUSSION

The weight of the available evidence is that the process of racial residential segregation is associated with generally deleterious health of African Americans, and particularly for poor pregnancy outcomes, but this evidence is limited in many regards. Although segregation and social outcomes have been studied for decades, analyzing segregation as a useful construct in epidemiologic research is still in its infancy. In 2003, Acevedo-Garcia et al. (36) reviewed the state of residential segregation and health research, making 4 recommendations: develop multilevel research designs, expand segregation research beyond black-white to include other ethnic and racial groups, consider interaction between racial and economic segregation, and further develop the conceptual framework in which to understand segregation and health. Much progress has been made in response to these goals, but much work remains in order to understand how to best measure segregation, understand mechanisms by which distal social forces become proximal social and biologic outcomes, and test amenable paths to intervention. Future research should consider several issues.

First, continued development of methodological and conceptual tools to better understand residential segregation is necessary. While many recent studies use multilevel thinking in both conceptual and statistical approaches, clarity is still needed regarding the relevant scale of effect (e.g., of the measured neighborhood), levels of interest, and mediating variables. The interesting findings of variable segregation effects across different dimensions such as clustering and isolation should encourage researchers to further investigate the multidimensional nature of residential patterns and health. Similarly, use of newer spatial indices of segregation as well as multigroup indices may provide more insight than repetitive use of the US Census-derived dissimilarity index. Although this review focuses primarily on racial residential segregation, it is clear that poverty concentration and economic segregation are closely linked with racial settlement patterns. Research considering the interaction of economic and racial segregation is still needed.

Second, the existing segregation-health literature can be decomposed into 2 broad categories: 1) segregation as an exposure in intensity studies and 2) segregation as a local exposure in intracity research. This distinction is extremely important. The body of work using single cities to explore the health effects of segregation is an extension of the neighborhood-effects literature (46); it posits that the neighborhood context in mostly black neighborhoods is different from that in mixed-race or predominantly white neighborhoods and therefore impacts health. This approach has the strength of finer spatial resolution of individuals nested within neighborhoods, but Oakes (63) has argued that counterfactual reasoning in research on neighborhood effects and health outcomes may suffer from unmeasured confounding by forces that select individuals into neighborhoods. In other words, individuals are not randomly assigned to neighborhoods within a city; thus, groups may not be exchangeable.

Intracity research, on the other hand, has tended to look at the average health of residents of metropolitan areas (although typically controlling for individual-level covariates such as age, gender, and risk behaviors) and uses the heterogeneity of segregation across metropolitan areas to make inferences about the impact of segregation net of individual characteristics. This approach posits that living in a city with higher segregation (e.g., greater exposure to institutionalized racism) negatively impacts the health of all black residents, regardless of the racial composition of their neighborhood of residence. While this approach offers a partial solution to the selection problem (e.g., segregation may be one of the previously unmeasured forces that differentially sort individuals), most such studies lose the spatial resolution to know how outcomes varied by neighborhood within metropolitan areas. Further extending the multilevel framework to include individuals nested within neighborhoods nested within an ample number of heterogeneous metropolitan areas could offer promising new insight.

Finally, the segregation-health literature could be greatly enhanced by utilizing longitudinal in addition to cross-sectional study designs. Longitudinal designs could be applied to individuals, neighborhoods, or metropolitan areas, each with different implications. Most of the pathways hypothesized between segregation and health act across the life course, but there is almost no literature that accounts for different levels of cumulative exposure across the life course and very little literature with prospective information on health outcomes. For some poor and minority individuals, living in highly segregated environments may not be a time-varying exposure but rather a life-long constant (38). However, there is evidence that intensity and intracity migration varies by race and economics and with regard to metropolitan segregation, suggesting that longitudinal comparisons could be meaningfully made between those living in high-versus low-segregated cities (50). Alternatively, neighborhoods or metropolitan areas could be followed longitudinally to better understand the relation between residential patterning and health. Such time-series approaches might be particularly fruitful in areas characterized by progressive gentrification or decay over time. Similarly, time-series, cross-sectional analysis of health patterns in cities across the decades could document health changes associated with changing segregation.

The vast majority of black Americans live in urban settings, many but not all of which are highly segregated. It is vitally important to understand how much of their health disparities are a result of specific dimensions of segregation and whether these disparities can be reduced either by policies that reduce segregation or interventions that reduce the impact of segregation.

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Author affiliation: Women’s and Children’s Center, Department of Epidemiology, Rollins School of Public Health, Emory University, Atlanta, Georgia (Michael R. Kramer, Carol R. Hogue).

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Conflict of interest: none declared.

REFERENCES


Environmental Impact of Minority Children Residing in Economically Disadvantaged Communities

Clark Atlanta University, School of Social Work

Shava Cureton, Student; Sandra Foster, Faculty Mentor

Abstract:
Children living in poverty are disproportionately at risk from and affected by environmental hazards. According to the Children’s Defense Fund in 2008, 14 million children in America were living in poverty. So not only are millions of children living in poverty but they are living in environments that are hazardous to their health. Impoverished children live in environments with heavily polluting industries, hazardous waste sites, contaminated water and soil, in old housing with deteriorating lead based paint, in areas with limited access to healthy food and more. Children residing in these toxic environments are either at risk or suffer from a myriad of health disparities such as asthma, cancer, lead poisoning, obesity and hyperactivity. This unfortunate reality is better known as environmental injustice. Environmental injustice recognizes that economically disadvantaged groups are disproportionately at risk from and adversely affected by environmental hazards. However, to remedy this dilemma, environmental justice seeks to address unfair burdens of environmental health hazards on low income communities.

The purposes of this project are to (1) examine the environmental living conditions and health conditions of children living in poverty (2) briefly provide insight into the history of environmental justice efforts (3) assess federal agencies involvement in combating environmental injustice issues and (4) propose recommendations to elicit a more committed, vigorous and targeted approach in executing measures to protect the health and development of children.
Disadvantaged Children Living in Poverty

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>African Americans</td>
<td>34.7%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>36.6%</td>
</tr>
<tr>
<td>White</td>
<td>9.0%</td>
</tr>
</tbody>
</table>

Source: Children’s Defense Fund

Environmental Living Conditions of Disadvantaged Children

- Heavily polluting industries
- Hazardous waste sites
- Contaminated water and soil
- In old housing with deteriorating lead based paint
- Adjacent to major roadways where hazardous substances are transported
- Lack of or limited green space
- Limited access to healthy food options

Superfund Sites in the United States

Source: www.scorecard.com
### Health Conditions of Disadvantaged Children

**Elevated Blood Lead Levels, ≥ 2.5 μg/dL**
- According to the National Center for Health Statistics (2008), over 40% of Black children (1-5 years of age), living in poverty had elevated blood lead levels, oppose to 12% of white children.

**ADD and ADHD Diagnoses**
- According to the National Center for Health Statistics (2008), 12% of White children, 10% of Black children and 5% of Hispanic children between the ages of 5–17 living below poverty had been diagnosed with ADD or ADHD.

### Health Conditions of Disadvantaged Children

- Higher rates of asthma, elevated blood lead levels, learning disabilities and hyperactivity (Powell & Stewart, 2001).
- Environmental chemicals have been closely linked to childhood cancer; children are more susceptible in utero or in early life (Woodruff, Axelrad, Kyle, et al., 2010).
- Obesity has become a clinical and public health problem but it has increased concern in environments where children are impacted by social and economic stressors (Rubin, Nodvin, Geller, Teague, et al., 2007).

---

**Asthma: Percentage of Children who had Asthma, 2001 - 2007**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
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<tbody>
<tr>
<td>Ages 0-5</td>
<td>6.2</td>
<td>6.4</td>
<td>6.3</td>
<td>6.4</td>
<td>7.2</td>
<td>6.9</td>
<td>7.1</td>
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<tr>
<td>Ages 6-10</td>
<td>9.2</td>
<td>8.6</td>
<td>9.4</td>
<td>8.3</td>
<td>10.0</td>
<td>11.4</td>
<td>9.1</td>
</tr>
<tr>
<td>Ages 11-17</td>
<td>10.1</td>
<td>9.7</td>
<td>9.8</td>
<td>10.3</td>
<td>9.6</td>
<td>9.9</td>
<td>10.9</td>
</tr>
<tr>
<td>Poverty status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below 100% poverty</td>
<td>10.8</td>
<td>11.8</td>
<td>10.9</td>
<td>9.6</td>
<td>10.6</td>
<td>12.2</td>
<td>11.4</td>
</tr>
<tr>
<td>100-199% poverty</td>
<td>8.6</td>
<td>7.8</td>
<td>8.3</td>
<td>9.3</td>
<td>8.6</td>
<td>9.5</td>
<td>8.9</td>
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<tr>
<td>Race and Hispanic origin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>11.1</td>
<td>11.7</td>
<td>13.4</td>
<td>12.4</td>
<td>13.1</td>
<td>12.8</td>
<td>15.4</td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>7.3</td>
<td>6.0</td>
<td>7.5</td>
<td>8.2</td>
<td>7.9</td>
<td>8.6</td>
<td>7.3</td>
</tr>
<tr>
<td>American Indian or Alaska Native</td>
<td>8.9*</td>
<td>12.0</td>
<td>16.2</td>
<td>6.4*</td>
<td>15.6*</td>
<td>7.3*</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>7.8</td>
<td>5.3</td>
<td>4.4*</td>
<td>3.4</td>
<td>6.5</td>
<td>6.8</td>
<td>7.4</td>
</tr>
<tr>
<td>Hispanic</td>
<td>7.2</td>
<td>6.3</td>
<td>7.4</td>
<td>6.9</td>
<td>9.6</td>
<td>9.0</td>
<td>9.3</td>
</tr>
<tr>
<td>Puerto Rican</td>
<td>18.2</td>
<td>17.3</td>
<td>20.6</td>
<td>18.4</td>
<td>19.9</td>
<td>25.7</td>
<td>14.8</td>
</tr>
</tbody>
</table>

* Source: National Center for Health Statistics, National Health Interview Survey.
Health Conditions of Disadvantaged Children

- The annual incidence of cancer in children increased from 129 to 166 cases per million children between 1975 and 2002 (Rosen & Imus, 2007).
- The Environmental Working Group released a study in 2005, which revealed an average of 200 industrial chemicals and pollutants in babies umbilical cord blood (Rosen & Imus, 2007).

Obesity Rates among Children, 2007

Cycle of Childhood Environmental Health Disparities
The Four Domains of Environmental Justice

- Knowing the Community
- Disproportionate impacts
- Meaningful involvement
- Fair Treatment

Source: EPA Office of Environmental Justice

Environmental Planning Recommendations

- Holding local, state and federal authorities responsible and accountable for the zoning, siting and permitting of environmentally hazardous enterprises (Grant Makers for Health, 2007).
- Healthy Homes Initiatives - Moving residents out of old housing with deteriorating lead-based paint to clean it up, then moving them back in.

Policy Recommendations to...

- Address existing environmental health risks and future ones
- Ensure safe and environmentally friendly housing
- Promote the development of green space
- Ensure community-based land use planning and economic development
- Empower and educate communities to take a stance on environmental justice issues
Community Partnership Recommendations

- Build partnerships with companies, organizations and institutions to develop interventions and initiatives to combat the everyday challenges of environmental justice.
  - Involvement of Home Depot and Lowes, construction companies and others to build environmentally friendly green space for children to play and to clean up these communities.
  - Environmental Health Media Campaigns: brochures, pamphlets, PSA’s, commercials.

Community Partnership Recommendations

- Improving Opportunities for Healthy Living Initiatives
  - Providing economic incentives for grocery store chains to locate in low income communities by providing financing options (Acevedo-Garcia, Ouyang, McArdle, & Williams, 2009).
  - Establishing Mobile Farmers Markets to come into communities and sell produce, accepting WIC and food stamps.
  - Establishing Community Gardens, which is a cost effective way to promote healthy eating practices and exercising habits.
  - Implementing healthy living initiatives in low income neighborhoods.

The key is combining community and public health interventions!
Second Hand Smoke Exposure in Children: Environmental Factors, Psychological Effects, and Interventions Within Pediatrics

George Washington University School of Medicine & Health Sciences
Department of Pediatrics and Environmental Health

Zoya Treyster, Student; Benjamin Gitterman, Faculty Mentor

Abstract:
Second hand smoke exposure has long been correlated with many adverse disease processes, particularly in children. Asthma quickly comes to mind and has been well studied in the past. However, recent literature has shown that the effects of smoking are far more detrimental than previously thought; smoking is now correlated with sleep disturbances, behavioral problems, ear infections, and cognitive development. For children growing up with socioeconomic disadvantages where rates of smoking are increased, exposure can have far reaching consequences. This paper explores both the effects and correlations of second hand smoke as they pertain to the socioeconomic disadvantages and seeks out novel ideas on decreasing exposure.
Cycle of Disadvantage and Disability

Environmental Disparities
- Socio-economic factors
  - Poverty
  - Employment
  - Education
  - Neighborhood characteristics
  - Urban/Suburban Disparity
  - Access to healthcare
- Cultural influence
  - Familial behaviors
  - Smoking in the home
  - Peer pressure
  - Individualism vs collectivism
  - Recreational activities
  - Perception of the medical profession

The Environment of a Child
- About 10% of women in the US smoke during pregnancy
- SHS exposure affects at least 50% of children in the US
- SHS exposure rates are more than twice as high in children as in adults

Domestic Dangers
- The main site of SHS exposure for children is in the home
- Of all children <18yo, 12% are exposed to SHS in their homes
- Consequences of third hand smoke exposure
- Smoking regulations, not reaching the home
Socioeconomic Risk Factors

- Smokers are more likely to:
  - Be below poverty level
  - Be African American
  - Have less education
  - Have higher rates of depression and anxiety

Effects of Smoking

- Sudden Infant Death Syndrome
- Child Development
- Asthma
- Infections: Lung, Ear, Teeth
- Cardiovascular
- Behavioral and psychological
- Increased likelihood of smoking initiation

Sudden Infant Death Syndrome

- SIDS is the leading cause of infant mortality from 1m-1y
- Maternal smoking correlated with 43%-61% of SIDS cases
- SIDS rates in African and Native American children are 2-3x the national average

Effects on Child Development

- Disrupts lung development
- Kids are short! They are in greater contact with particles that settle closer to the ground
- Kids have a larger surface to volume ratio and high metabolic rates
Asthma

- African American children were 3x as likely to be hospitalized & 4x as likely to die from asthma
- SHS exposure is associated with current, ever, and incident asthma

- Asthma incidence steadily increasing

Infections

- Research consistently links SHS to various illnesses:
  - Otitis media
  - Septic & meningitis
  - Dental caries in deciduous teeth

Cardiovascular

- Infants of smokers show heightened cardiac reactivity
- Sustained deregulation at 1 yr follow up
- CV effects in children of mothers who smoked persist into adulthood

Behavioral Problems

- Correlation observed as early as the newborn period
  - Excessive crying
  - Infantile colic
  - Increased fussiness
  - Protesting behavior during baths
  - Less attention to parents during play activities

- Children age 5-17 with SHS exposure in the home were significantly more likely to have behavioral problems at a rate of 17% compared to 9% in controls
Smoking: Perpetuating the Cycle

- Parental smoking was associated with a significantly higher risk of smoking initiation in offspring
  - One parent
    - 1.5x as likely
  - Both parents
    - 2.75x as likely

Role Of Pediatricians: Are They Helping?

- Patients are rarely:
  - counseled on the risks of modeling smoking behavior
  - recommended pharmacotherapy
  - given a prescription for a smoking cessation medication

- Pediatricians: Common Barriers
  - lack of training
  - lack of time
  - low confidence in effectiveness

Most Residency programs DO NOT include tobacco in their curriculum.

Why Should Pediatricians Discuss Quitting With Parents?

- Patients go to a pediatrician’s office more frequently than that of their own primary care physicians
  - 4 pediatric visits per year
  - 10 visits in the first two years of a child’s life

- Particularly relevant for the underserved and uninsured!
  - Many do not have access to a primary care physician
  - May only have access to the healthcare system through their children

Reaching ISDD Goals--What Pediatricians Can Do

- Prochaska’s model of health behavior change
  - Pre-contemplation
  - Contemplation
  - Preparation
  - Action
  - Maintenance

Always consider socioeconomic and cultural factors!!
Getting Parents to Quit

- “5 A’s” method set forth in guidelines
  - Ask
  - Advise
  - Assess
  - Assist
  - Arrange

Change Residency Education

- Residents who receive training are more likely to:
  - ask
  - advise
  - help set a quit date
  - follow up
- Residents reported improved confidence in their counseling skills
- Parents were more likely to report that they had received tobacco counseling

Advocacy

The American Academy of Pediatrics encourages physician involvement in advocacy for policies that protect children from SHS exposure and elimination of tobacco use in the media, public places, and homes

Breaking the Cycle

- SHS exposure has many detrimental effects on children’s health, particularly for those in low socioeconomic circumstances where environmental exposure accentuated a higher baseline risk.
- Pediatricians may be extremely influential in breaking the cycle.

Thank you!!
General Knowledge of Mercury and Lead Exposure to Women of Childbearing age in Duval County, Florida

University of Florida, College of Medicine and College of Public Health

Victoria Chau, Student; David Wood and Katryne Lukens-Bull, Faculty Mentors

Abstract:
Duval County, Florida is a county with a long history of environmental health hazards, especially prevalent within its urban core. Forty one percent of Duval County’s African Americans residents reside in the urban core, referred to as Health Zone 1. HZ 1 is disproportionately poor and is burdened with worse health outcomes and higher environmental contaminants, including high mercury emissions, than the rest of the county. This study specifically focuses on mercury exposure which can cause severe neurological and developmental impairment to a mother’s fetus. A mercury exposure survey for women’s health providers throughout Duval County was conducted to better understand the education being provided. The outcome goal is to lessen the health disparities among residents by providing and promoting the use and distribution of an educational packet to all women’s health clinics in Duval County to raise awareness and prevent prenatal exposure to environmental mercury.
**Health Zone 1**

<table>
<thead>
<tr>
<th>Health Zone</th>
<th>Key Health Indicators</th>
<th>Infant Mortality by Health Zone, Duval County, 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 1</td>
<td>Preterm</td>
<td>Education level</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High school or graduate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unmarried in poverty below 10%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average median income</td>
</tr>
<tr>
<td></td>
<td></td>
<td>African American population</td>
</tr>
</tbody>
</table>


**Preterm Birth by Health Zone, Duval County, 2007**

**Prenatal Care by Health Care, Duval County, 2007**
**FDEP and EPA Ash Sites by Zip Code, Duval County, 2006**

**Ash and other Contaminants**

- **Lead**
- **Mercury**
- **Arsenic**
- **Polychlorinated Biphenyls (PCBs)**
- **Polycyclic Aromatic Hydrocarbons (PAHs)**
- **Dioxins**
- **Soil, Water, and Sediments**


**Positive Lead Tested Houses by Zip Code, Duval, 2006**

**WHAT IS MERCURY**

- **Elemental Mercury**
  - Metal form/liquid mercury
  - Thermometers, thermostats, sphygmomanometers, batteries, dental amalgams, children's toys, light switches, and fluorescent light bulbs

- **Inorganic Mercury**
  - Salt form/white crystalline powder
  - Ocean, rocks, volcanoes, and soils
  - Coal-burning power plant emissions

- **Organic Mercury (Methylmercury)**
  - Carbon-containing mercury compound
  - Underwater/Fish

Health Effects to a Fetus/Young Child

- Methylmercury penetrates the placenta and enters a fetus's nervous system
- Cognitive thinking, memory, attention, language, and fine motor and visual spatial skills
- Symptoms of methylmercury poisoning may include:
  - Impairment of the peripheral vision
  - Disturbances in sensations ("pins and needles" feelings, usually in the hands, feet, and around the mouth)
  - Lack of coordination of movements
  - Impairment of speech, hearing, walking, and muscle weakness

U.S. Environmental Protection Agency (2009c, October 19). Mercury: basic information.

Break the Cycle of Mercury Exposure in Women of Childbearing Age

- Lake
- Ocean
- Atmospheric Deposition
- Wetland Dry Deposition
- Mercury transforms into methylmercury in soil and water, then can bioaccumulate in fish

Impacts
- Women in the developing infant
- Impaired motor and cognitive skills
- Possibly other impacts

Consumption Patterns
- Break the cycle by increasing awareness


Monitoring Systems

- PRAMS (Pregnancy Risk Assessment Monitoring System)
  - Survey conducted in each state by state health departments and the CDC
  - Designed for pregnant mothers to better understand health behaviors and environments that will improve the health of infants in the future
  - "reduce low birth weight, infant mortality and morbidity, and maternal morbidity"
  - 2009 FL PRAMS asked if during prenatal care "how eating fish of high mercury levels could affect your baby" was discussed


Duval County Risk Factors for Mercury Exposure

- Coastal Community
- Sport fishing
- Power Plant Emissions
- Mercury polluted water and land

Effects of Risk Factors

- Fish consumption

Direct Link to Humans

- Human exposure to mercury

### Total Women Surveyed

| Exceeded Recommended RfD of 1.0 µg/g of Hg in Duval County (%) | 7.0 |
| Heard About Limiting Fish Consumption Due to Mercury (%) | 63.4 |
| Consume Local Fish (%) | 61.7 |
| Health Zone 1 (%) | 57.6 |
| Health Zone 6 (%) | 80.4 |
| Aware of Local Fish Advisories (%) | 15.7 |
| Consume Local Fish (%) | 21.3 |
| Health Zone 1 (%) | 15.0 |
| Health Zone 6 (%) | 23.2 |


### 2009 Duval County Mercury Biomonitoring Study Results

#### Age, Education, and Income
- Increased mercury awareness among those with greater age, education, and income.

#### Race
- Caucasians and Asian/Pacific Islanders had higher mercury awareness
- African-Americans had lowest mercury awareness

#### Health Zone
- Beaches/KZ 6 had highest mercury awareness
- Urban Core/KZ 1 had lowest mercury awareness
- KZ 1, 5, 6 had higher fish consumption


### Mercury Exposure Education Provider Survey

- Fax version and Telephone version
- 68 Provider offices
- Surveys mercury exposure education practices and perceptions of women’s health providers
- Collect written materials for future education packet

### 68 Women’s Health Provider Clinics and Centers Map

Source: Google maps created by Victoria Zhou
Abstract:
Substandard housing conditions have been linked to widespread childhood environmental health ailments, including two of the leading causes of childhood morbidity: lead poisoning and asthma (Breysse 2004; Krieger 2002). In 2009, the national public health agenda called for action around healthy homes (CDC 2009; HUD 2009; US DHHS 2009). Improving home health environments can alleviate the cycle of childhood morbidity and mortality. The North Carolina Department of Environment and Natural Resources is working to build capacity at the state-level to respond to home health needs. This project will provide written and oral recommendations to the NC Healthy Homes program to develop an assessment tool and educational materials addressing these concerns.
Healthy Homes: Definition

Healthy Homes: National Trends

Children’s Environmental Health
Two leading causes of childhood morbidity:

<table>
<thead>
<tr>
<th>Condition</th>
<th>NC</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead Poisoning</td>
<td>0.4%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Asthma</td>
<td>13%</td>
<td>9.4%</td>
</tr>
</tbody>
</table>

- Rural
- Socioeconomic status
- Age of housing stock

Healthy Homes: Reducing Disparities

Individual Risk Factors
- Policies/Cultural Norms
- Social Determinants

Health Outcomes
- Environmental Determinants
Healthy Homes: Reducing Disparities

- Seattle-King County (WA)

<table>
<thead>
<tr>
<th>Primary Outcome</th>
<th>High-Intensity Group (n=116)</th>
<th>Low-Intensity Group (n=104)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline yrs.</td>
<td>Exit</td>
<td>Baseline</td>
</tr>
<tr>
<td>Days with symptoms ≥ 2 weeks</td>
<td>8</td>
<td>3.2</td>
</tr>
<tr>
<td>Greater quality of life score</td>
<td>4.4</td>
<td>5.6</td>
</tr>
<tr>
<td>Urgent health services used ≥ 2 months (%)</td>
<td>25.4</td>
<td>8.6</td>
</tr>
</tbody>
</table>

North Carolina Healthy Homes Program

- Following national trends:
  - "Healthy Homes Transition" goal
  - Capacity at DEHR
  - Guilford County, NC

Number of Children Aged 1 and 2 Years with Elevated Blood Lead Levels

- Number of Children: 10
- Number of Counties: 10
- Number of Towns: 30
Assessment Tool

- Purpose: Why assessment?
- Methods
  - Review
  - Development
  - "Focus group"
  - Field testing
- Results

NC Healthy Homes: Educational Materials

- Purpose: Why educational materials?
- Results
  - Factsheet
  - Green Cleaning
  - Coloring Pages
  - Other?
NC Healthy Homes: Next Steps

- Roll-out in May-July of assessment form in CLPPP projects
- Planning for evaluation and data-management
  - Reducing disparities?

Acknowledgements

- Amy MacDonald, University of North Carolina Chapel Hill, Institute for the Environment
- Arjun and Siddiqi, University of North Carolina Chapel Hill, Gillings School of Global Public Health
- Members of NC Department of Environment and Natural Resources and the Lead Healthy Homes Coalition
- Emory University and PEHSU Staff
Ways to Care for your Air:
Air inside the Built Environment and Common Pollutants in it
Henry Slack, EPA, Region 4
Care for Your Air
Indoor Air Quality (IAQ)

Henry Slack
EPA Region 4
slack.henry@epa.gov
404-562-9143
6 May 2010

Help from EPA
• EPA Indoor Air Resources
  http://www.epa.gov/iaq

• EPA IAQ Clearinghouse – IAQ INFO
  (800) 438-4318
  (ask questions, order pubs)

Does this home have a problem?

• How would you know?
  – Odors
  – Feel sick
  – “Not right”
  – I know it when I smell it

History
• Older buildings
  – stone, brick, plaster (high pH), natural wood (absorbs H2O), rugs

• New buildings
  – concrete (porous), dry wall (neutral pH), pressed wood products, carpet (cannot remove to clean)
History II

- Pre-1950's, open windows = natural ventilation. Outdoor Air = Indoor Air
- Indoor wood can absorb moisture. Newer home = less wood, absorbs less moisture

What's In Our Air?

What Is It?

- TOXIC RADON
  - Radioactive gas
  - 2nd leading cause of lung cancer
  - 21,000 deaths yearly
  - Prevent: $500-$2500
  - TEST YOUR HOME!
  - Fix only w/ certified

What Is It?

- Carbon Monoxide
  - "Head" symptoms: dizzy, nausea, headache, tired, confused, flu-like
  - From unvented heaters, tailpipes, broken combustion equipment
  - No charcoal or generators indoors!
What Are They?

- Volatile Organic Chemicals (VOCs)
- Headaches, rash, respiratory symptoms
- From “wet” building products, pressed wood (formaldehyde), pesticides

What Are They?

- Biological contaminants
  - Cat dander
  - Pollen
  - Roach or rat droppings
  - Dust mite droppings
  - Mold
- Allergy, irritation, etc.

Health Effects from Biologicals

- Infections
  - Contagious (colds, flu, TB, measles)
  - Enviro-source (Legionella, Histoplasma)
- Hypersensitivity Diseases
  - Allergy, asthma, Hypersensitivity Pneumonitis (HP)
- Toxiscoses (mycotoxins, endotoxins)

EPA on Molds

- Popular guidance
- NO REGULATIONS
- Health Effects in Appendix B
Health Effects from Molds

- Headaches, skin irritation
- Allergic reactions
- Aggravation of asthma symptoms
- Other symptoms possible
- HP and Aspergillusosis - rare
- Mycotoxin effects ("toxic mold")

Big Ideas about Molds

- Mold = MOISTURE. Get rid of both!
- Sample only for medical or legal reasons, or to find hidden mold
- No Federal mold standards
- No EPA regulations for cleanups
- Biocides not recommended routinely

What We Didn’t Cover

- Lead-based paint
- Asbestos
- Tobacco Smoke
- Sewer Gases
- Pesticides

Why IAQ Problems Vary

- Individuals vary
  - Genetics, age, respiratory history
  - Chemical sensitivity
- Cumulative or interactive effects
- Time (seasons, time of day)
- Regions vary – humidity, pollen, etc.
Finding IAQ Problems

- Talk to occupants (esp. maintenance)
- **Visual Assessment** – look for sources
  - IAQ “walk through”
- Then fix problems!
- Testing expensive, often ineffective
  - Cannot identify sources, health concern

What can we do for indoor air?

- **CONTROL** pollution sources
  - If inside, cover it or replace it
  - If outside, don’t bring it in!
- **VENTILATE** to remove pollutants
- **FILTER** the air, whether recirculated or “fresh”

Source Control I – Keep It Out!

- Use low-emitting materials:
  - paints, adhesives, carpets, wood products
- Use Green Cleaning – fewer odors, ventilate it
- No Smoking in the house
- Seal ductwork, garage connections, etc.
- Trap dirt at doors (walk-off mats)

Source Control II – If in, control it

- Keep caps on chemicals as much as possible
- Use HEPA vacuum cleaners, floor buffers to capture particles
- Capture or exhaust dust or fumes from any other activities (hobbies, cooking)
Controlling Mold

- **Moisture Control KEY to Mold Control**
  - Use of antimicrobials (like bleach) not recommended routinely
  - You see mold, it’s there. No need to sample -- no gov’t standards for comparison
  - Solve the moisture, then remove moldy material. Discard moldy porous items.

Ventilation

- Run exhaust fans - remove moisture, odors
- Consider Energy Recovery Ventilator (ERV) to bring in outside air
  - To replace air removed by exhausts
  - To dilute contaminants
- Open windows in “nice” weather
- Consider sealing crawlspace, attic

Filter or clean the air

- Filters now rated by Minimum Efficiency Rating Value (MERV)
  - MERV range 0 (lousy) to 20 (HEPA)
  - Higher MERV takes bigger fan
    - Homes, MERV 6+ (1” pleated filter)
    - Office, MERV 8+
- Too high costs more money AND energy
- Room “air purifiers” never a full solution

Exposure Control

- Move people away from the problem
- For a day, or nightly, or more
- Temporary (vacation) or permanent
- Workers - Different office, building
- Homeowners – change bedroom? Sell?
- Renters - can move
EPA’s Asthma Program

- Children and parents
- Health professionals
- Communities/Parties
- Media (“Goldfish”)
- Asthma Community

IAQ Tools for Schools

- Schools have 20% of population, numerous IAQ problems possible
- EPA’s IAQ Tools for Schools
  - Voluntary and flexible
  - Low- and no-cost methods
  - Focus on Team and communication
  - Save $$, raise test scores

Getting Help Elsewhere

- Health departments (sometimes)
- Extension agents (often)
- OSHA for workers
- NIOSH (800-CDC-INFO) (workers)
- Fire department (emergency)
- Building code (water) and elected officials
- Private physicians, attorneys, media

Help from EPA

- EPA Indoor Air Resources
  [http://www.epa.gov/iaq](http://www.epa.gov/iaq)
- EPA IAQ Clearinghouse – IAQ INFO
  (800) 438-4318
  (ask questions, order pubs)
Abstract:
The objective of this study is to assess potential effects of environmental factors, including pesticide exposure, built, social, and family environment, on the development of childhood obesity. A total of 6,770 subjects aged 6-19 were selected in the 2003-2004 and 2005-2006 National Health and Nutrition Examination Survey (NHANES). Exposure to environmental pesticides was assessed based on the levels of pesticide residues in urine. Multivariate logistic regression was performed using SAS 9.1.3 to assess the association between pesticide exposure and childhood obesity with the adjustment of potential confounders, including age, gender, race, socioeconomic status, and total fat intake. The study found a significant dose-dependent association between interquartile urinary 2,5-dichlorophenol (2,5-DCP) levels and childhood obesity. However, urinary levels of 2,4-dichlorophenol was not shown to be significantly associated with childhood obesity. Perceptions from children and adolescents in the focus groups identified specific areas under the built, family and social environment that affect obesity-related lifestyle factors.
Childhood Obesity

- Childhood obesity is a multifaceted problem that can be due to a number of factors:
  - Behavioral, genetic, and environmental factors.
- Approximately 17% of children in the age group 2-19 years are obese (NHANES).
- Obesity in children is a predictor of whether a person will be overweight or obese in adulthood.
- Obese children are at increased risk of developing serious complications, such as:
  - High blood pressure, high cholesterol, type 2 diabetes, metabolic syndrome, and depression.

Environmental Factors and Childhood Obesity

Environmental factors that could be associated with obesity:

- Air, Water, Food, Soil, and Consumer Products
  - Exposure to environmental chemicals, such as pesticides, may be associated with the development of obesity in children.
- Built Environment
  - The built environment within communities influences access to physical activity opportunities and access to affordable and healthy foods.
- Family Environment
  - The interaction between parent and child and the home environment have the potential to affect the behaviors of children and youth with respect to their caloric intake and physical activity.
- Social Environment
  - Friends play significant roles in helping children maintain healthy lifestyles.

Pesticide Exposure and Childhood Obesity?

- According to the U.S. EPA, U.S. pesticide sales in both 2002 and 2001 exceeded 3.2 billion pounds, accounting for more than 10% of total world pesticide sales used.
- Types of chemical pesticides:
  - Organochlorine pesticides
  - Organophosphate insecticides
  - Pyrethroid pesticides
  - Carbamate pesticides
- Organochlorine pesticides are highly persistent and highly lipophilic and therefore can accumulate and persist in adipose tissue after ingestion.
- Several studies have suggested an association between concentrations of persistent organic pesticides and their byproducts in obese individuals.

Dichlorophenols

- 2,4-Dichlorophenol (2,4-DCP)
  - Used primarily as an intermediate in the preparation of the herbicide 2,4-dichlorophenoxyacetic acid (2,4-D).
  - Commercial pesticides that contain 2,4-D include Aquia-Kleen, Barrage, Lasso-IP, Malathion, Pancratin, Pursuit, Savvy, Solo, Weedone, and Weedtrine.
- 2,5-Dichlorophenol (2,5-DCP)
  - A major metabolite of para-2,4-dichlorophenoxyacetic acid.
  - Used as a pesticide, mothballs, and deodorant.
  - Commercial products that contain 2,4,5-DCB include Parathox, Micro-Care, Molot, Meth Killer, Sorento, Black, and Durocare.
Possible Exposures to Chlorophenols

- Children playing in playground where pesticides are used may also be exposed.
- Children may be exposed to pesticides through maternal exposures.
- Exposure to low levels through chlorine-disinfected drinking water (parts per trillion).
  - Children consume large amounts of fluid than adults and therefore might be exposed more.
- High level exposure for people who make chlorophenols or use them as pesticides.

Cycle of Environmental Health Disparities

Project Design

Project Design

- Quantitative analysis of data from the National Health and Nutrition Examination Survey (NHANES) to access the relationship between exposure to pesticides and childhood obesity.

- Qualitative analysis: To further explore how other environmental factors affect obesity in children, three focus groups with children and adolescents between the ages of 12 and 19 were conducted.
Quantitative Analysis

- **Who?**
  - Survey participants aged 6 to 13 from NHANES for the years 1999 to 2000.
  - Sample Size = 6770

- **What?**
  - Obesity using BMI, age, and gender
  - 2,4-DCP and 2,5-DCP measured from urine samples in µg/L

- **Statistical Analysis**
  - Multivariate stepwise logistic regression, adjusting for age, sex, race, income, and total fat intake.
  - Dependent Variable = BMI
  - Independent variables = 2,4-DCP and 2,5-DCP concentrations in urine
  - SAS 9.3 was used for analysis.

---

Demographic Characteristics and Childhood Obesity

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th># Obese</th>
<th>% Obese</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>6770</td>
<td>1045</td>
<td>21.14</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>N</th>
<th># Obese</th>
<th>% Obese</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-12 years</td>
<td>2748</td>
<td>614</td>
<td>22.34</td>
<td>1.00</td>
</tr>
<tr>
<td>13-19 years</td>
<td>4022</td>
<td>631</td>
<td>20.66</td>
<td>0.92 (0.81, 1.04)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th># Obese</th>
<th>% Obese</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>3370</td>
<td>706</td>
<td>20.95</td>
<td>1.00</td>
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<tr>
<td>Female</td>
<td>3400</td>
<td>739</td>
<td>21.74</td>
<td>0.95 (0.85, 1.07)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Race</th>
<th>N</th>
<th># Obese</th>
<th>% Obese</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>1781</td>
<td>111</td>
<td>17.44</td>
<td>1.00</td>
</tr>
<tr>
<td>Black</td>
<td>2314</td>
<td>526</td>
<td>22.73</td>
<td>1.38 (1.17, 1.62)</td>
</tr>
<tr>
<td>Other</td>
<td>3673</td>
<td>608</td>
<td>22.75</td>
<td>1.32 (1.13, 1.54)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Income</th>
<th>N</th>
<th># Obese</th>
<th>% Obese</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;$50,000</td>
<td>3412</td>
<td>779</td>
<td>22.85</td>
<td>1.00</td>
</tr>
<tr>
<td>$50,000+</td>
<td>3113</td>
<td>412</td>
<td>13.66</td>
<td>0.88 (0.78, 0.99)</td>
</tr>
</tbody>
</table>

---

Pesticides and obesity: Unadjusted Results

<table>
<thead>
<tr>
<th>Pesticides</th>
<th>Range (µg/L)</th>
<th>N</th>
<th># Obese</th>
<th>% Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,5-DCP</td>
<td>Q1 (&lt;25th)</td>
<td>5.70</td>
<td>5134</td>
<td>1062</td>
</tr>
<tr>
<td></td>
<td>Q2 (25-50th)</td>
<td>5.70-17.50</td>
<td>525</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>Q3 (50-75th)</td>
<td>17.50-74.60</td>
<td>527</td>
<td>152</td>
</tr>
<tr>
<td></td>
<td>Q4 (75th+)</td>
<td>74.60</td>
<td>524</td>
<td>139</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pesticides</th>
<th>Range (µg/L)</th>
<th>N</th>
<th># Obese</th>
<th>% Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,4-DCP</td>
<td>Q1 (&lt;25th)</td>
<td>0.60</td>
<td>5199</td>
<td>1098</td>
</tr>
<tr>
<td></td>
<td>Q2 (25-50th)</td>
<td>0.60-3.10</td>
<td>501</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Q3 (50-75th)</td>
<td>3.10-15.70</td>
<td>507</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>Q4 (75th+)</td>
<td>15.70</td>
<td>533</td>
<td>127</td>
</tr>
</tbody>
</table>

Association between Pesticide Exposure and Childhood Obesity

<table>
<thead>
<tr>
<th>Pesticides</th>
<th>Adjusted OR</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,5-DCP</td>
<td>1.00</td>
<td>Lower Limit</td>
</tr>
<tr>
<td>2,4-DCP</td>
<td>0.99</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*Adjusted for age, gender, race, income, and total fat intake.

(DCP = Dichlorophenyl)
Qualitative Analysis: Focus Groups

- 3 focus groups
  - 2 middle school groups (12 to 14 years) and 1 high school group (15 to 19 years).
  - 1 White group and 2 African American groups

Perceptions of Other Environmental Factors Affecting Childhood Obesity

- Family Environment
  - Parental control
  - Influence of other family members

- Social Environment
  - Decreased social status
  - Decision making process
  - Active vs. sedentary friends

- Built Environment
  - Community recreational centers
  - Walkability of neighborhoods
  - Schools

Conclusion

- Results from this project suggest the association between 2,3-DCP levels in urine and obesity in children.

- Exploration of other environmental factors associated with childhood obesity revealed perceptions relating to the built, family, and social environment.

- Individuals can reduce their exposure to pesticides by buying organic foods (but NOT a realistic option for low-income families and families who live in areas where organic foods are not available).

- Possible directions for Obesity Intervention
  - Extending educational approaches beyond the child and parents to other members of the family and caregivers.

- Motivation to comply
  - Using scenarios from others they admire or support (friends and family) to push children in the positive direction of healthy eating and physical activity.

- Beyond the individual
  - Urging stakeholders in the community to provide safe areas for children to play and stay active.
  - Improving regulations regarding pesticide residues allowable on food.
Limitations

- Since this was a cross-sectional study, a causal relationship cannot be deduced.
- Other chlorophenols were not analyzed due to the limitation of the data.
- Other environmental chemical exposures, such as dioxins, PCBs, phenols, might be additional confounders.
- There was a lack of exposure data for age 2-5.
- Sample size can be increased for analysis.

Future Work

- More research is needed in order to explore the possible association of pesticides and other environmental chemicals as they relate to obesity especially in children.
- Interventions aim at addressing environmental factors relating to obesity should be ecological: it should involve all possible environmental factors, genetic predisposition, and health behaviors.

Acknowledgements

- Break the Cycle of Children’s Environmental Health Disparities, Southeast Pediatric Environmental Health Specialty Unit at Emory University.
- All faculty and students in Break the Cycle 5.
Childhood Obesity in Poor and Minority Children

Georgia State University, College of Law

Raymond Lindholm, Student; Charity Scott, Faculty Mentor

Abstract:

Childhood overweight and obesity has reached epidemic proportions, with nearly one out of every three children being affected. It has become increasingly evident that factors in the built environment are closely correlated to childhood obesity. Negative built environment factors disproportionately affect poor and minority children. This paper examines the current research on the state of childhood overweight and obesity, and surveys pertinent built environment factors. Examining the built environment from a legal perspective, this paper identifies how zoning, legislation, public/private partnerships, contracts, and litigation are being used to combat the childhood obesity epidemic. Using these tools, local, state, and national government agencies are increasing access to healthy food, decreasing density of unhealthy food sources, and increasing physical activity resources for obese children.
1. Framing the Issue: Childhood Obesity in the United States

<table>
<thead>
<tr>
<th>Age</th>
<th>% Overweight</th>
<th>% Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ages 2-5</td>
<td>21.2</td>
<td>10.4</td>
</tr>
<tr>
<td>Ages 6-11</td>
<td>35.5</td>
<td>10.6</td>
</tr>
<tr>
<td>Ages 12-19</td>
<td>34.2</td>
<td>11.1</td>
</tr>
<tr>
<td>Ages 2-19</td>
<td>31.7</td>
<td>10.9</td>
</tr>
</tbody>
</table>

Obesity Rates in 2007 – 2008 (95% CI)*

Data from the 2007 – 2008 National Health and Nutrition Examination Survey

Disproportionate Impact Age 2 – 19*

Ramifications of Childhood Obesity

Health
- Cardiovascular Disease
  - Hypertension / High Blood Pressure, Left Ventricle Hypertrophy, Atherosclerosis
- Metabolic Disorders
  - Insulin Resistance, Lipidemia
  - Type II Diabetes Mellitus
    - Also called "Adult Onset Diabetes"
  - Metabolic Syndrome
    - Only 4% in Healthy Children, but 30% in Obese Children
- Pulmonary Complications
  - Asthma, Obstructive Sleep Apnea
- Gastrointestinal Disorders
  - Liver disease, Gastroesophageal Reflux
- Skeletal Abnormalities

Psycho-Social
- Psycho-Social Issues
  - Depression, suicide, friendship & social interaction
- Quality of Life
  - Similar to children diagnosed with cancer
  - With obstructive sleep apnea, similar to children undergoing chemotherapy.
- Lower Life Expectancy
  - Estimated 25% lower for obese young-adults today
Ramifications of Childhood Obesity

Economic

- Females who become Obese Adults
  - Have less education
  - Lower earning power
  - Higher likelihood of poverty
  - Lower likelihood of marriage

- Obese Individuals
  - Less likely to be admitted to college
  - More likely to experience housing discrimination
  - More likely to experience employment discrimination

- High Economic Cost
  - Direct medical costs of childhood obesity: $6.34 billion annually
  - Direct medical costs of adult obesity: $147 billion annually
  - Additional Costs:
    - Lower productivity, obesity-related job absenteeism
    - Other costs: lower education, more reliance on government programs, 
      lower earning potential

2. Role of the “Built Environment”

- Homes
- Schools
- Office Buildings
- Parks
- Green Space
- Transportation

Disparities in the Built Environment

- Safety
- Litter & Garbage
- Dilapidated Houses
- Vandalized & Abandoned Houses
- Sidewalks & Paths
- Parks or Playgrounds
- Recreation & Community Centers
- Libraries or Bookmobiles
- Supermarkets & Farmers’ Markets
- Fast Food and convenience stores

As a Result:

- Children who live in neighborhoods with the least favorable built environment factors:
  - 50% more likely to be physically inactive
  - 52% more likely to watch television more than two hours per day
  - 65% more likely to engage in recreational computer use more than 2 hours per day
- Children living in neighborhoods with the fewest health-amenities:
  - 104% more likely to be obese
  - 55% more likely to be overweight
- Heaviest hit are girls age 10 – 11
  - 276% more likely to be obese
  - 121% more likely to be overweight
Built Environment Factors
Relationship to Obesity

- Unsafe Neighborhoods
  - Due to Crime, Traffic Density, Litter & Trash, Poor Lighting
  - 61% more likely to be Obese; 43% more likely to be overweight
  - 26% of black children and 23% of Hispanic children are reported to live in unsafe neighborhoods, compared with 8% of white children.
- No Access to Sidewalks or Walking Paths
  - 32% higher adjusted odds of obesity
- No Access to Parks or Playgrounds
  - 26% higher adjusted odds of obesity
- No Access to Recreation or Community Centers
  - 20% higher adjusted odds of obesity

3. Legal Paradigms

- Legislation
- Litigation
- Contracts
- Public/Private Initiatives
- Zoning

Problem: Access to Healthy Food Sources

- 68% of low-income individuals have limited or no access to supermarkets
- Barriers to entry are high:
  - Annual profit margins are razor-thin
  - Complex Regulatory Environment
  - Difficult to attract and retain employees
  - Insurance for high-crime areas can be prohibitive
  - Many small grocery chains do not have the resources to conduct complex market analysis
  - Finding financing for expanding into underserved markets can be very difficult

Legal Perspectives & Solutions

- Problem involves many different legal facets:
  - Zoning
  - Design & Construction Law
  - Complex Regulations & Permitting
  - Financing
  - Tax Law
  - Insurance Law
  - Employment Law
  - Criminal Law
Initiatives to Lessen the Grocery Gap

- Streamline Permitting & Zoning Process
  - Retail Chicago
- Taxes
  - Eliminate Sales Tax on Healthy Food Items
  - Offer tax incentives to improve/increase selection
- Special Security Units
  - Collaborate with local law enforcement to provide onsite security
- Public/Private Initiatives
  - Government Resources + Private Sector Know-how = ©
  - Local Level
    - New York City & New Orleans
  - State Level
    - Pennsylvania’s Fresh Food Financing Initiative
  - National Level
    - $400 million for FY2011 federal budget
- Policy Groups
  - The Food Trust, Policy Link

Community & Urban Gardens

- Sources of fresh fruits and vegetables
- Outlets for physical activity
- Venues for community gatherings
- Create green space

Legal Perspectives

- Legal Issues
  - Land-Use
    - Comprehensive Plan
    - Zoning Code
  - Privately held land
    - Trespass
    - Tax & Utility Liens
  - Publicly held land
    - Use is subject to government prerogative
- Liability
- Insurance
- Financing

- Legal Solutions
  - States & Municipalities can:
    - Provide financial support
    - Identify vacant land for use
    - Operate their own community gardens
  - Land Trusts
  - Conservation Easements
  - Long-term Lease Agreements
- Model Policies
  - National Policy and Legal Analysis Network to Prevent Childhood Obesity
  - www.splanonline.org

School Agricultural Programs
Other School Programs

- State Programs
  - Improving school lunch & breakfast nutrition guidelines
- Using schools as community markets after school and on weekends
- Private Organizations
  - The Food Trust
    - School Market Program
    - Healthy Corner Store Initiative

Problem:
Density of Fast Food Restaurants

Zoning to Limit Access

- Zoning and Public Health
- States & Municipalities Have Used Zoning
  - Banning Fast Food Restaurants
    - Place: Concord, MA
    - Justification: Lessen congestion and preserve aesthetics
  - Banning “Formula” Restaurants
    - Calistoga, CA; Preserve historic character of downtown to protect city’s economy
  - Banning Only in Certain Areas
    - Solvang, CA; to preserve Danish character in tourist district
    - San Francisco, CA; in commercial districts to protect small business

Zoning (cont.)

- Regulating by Number
  - Berkley, CA: Elmwood Commercial District
  - Justification: preserve character of neighborhood
- Regulating Density
  - Town of Warner, ND: Regulate distance between fast-food restaurants and density through design guidelines
- Regulating Distances from Other Uses
  - Detroit, MI: places a minimum distance between fast-food restaurant and elementary, junior, and senior high school sites.
- Courts have upheld these zoning restrictions
  - Zoning to preserve aesthetics, economic interests, and traffic congestion
  - With obesity shown to be a serious public health epidemic, courts will probably uphold on this basis as well.
Active Transportation Infrastructure

• Problem:
  – Kids don’t walk & ride to school
  – Neighborhoods don’t have sidewalks and infrastructure to walk and bike to schools, parks, trails, stores, and businesses

Legal Perspectives

• Legislation
  – “Complete Streets” Programs
    • Requires cities and counties to amend their “comprehensive plans” so that all roadways are designed to safely accommodate all users
    • Portland, OR experienced a 74% increase in bicycle traffic after implementing a “Complete Streets” program in the 1990’s
  – Safe Routes to School Programs
    • Provides evaluation, education, & engineering to cities and counties to improve active transportation to school
    • $612 million in federal grants to States until 2009
    • SRTS reauthorization is planned for the 2010 Transportation Bill

Access to Physical Recreation Resources

• Problem
  – Many poor communities lack access to physical recreation facilities
  – Many schools have these but lock the facilities after school hours.

Legal Perspectives

• Issues:
  – Land use
  – Tort liability
  – Insurance
  – Funding for projects

• Solutions
  – Legislation
    • Community Use
      – Enables school districts to enter into joint-use agreements
      – Extends governmental immunity from law suits
  – Contracts
    • Joint-Use Agreements
Conclusion

• Good News: ☺
  – Increasing awareness of the Obesity Problem
  – Mobilization on multiple levels in both Private and Public spheres
  – Great desire to implement change
• Bad News: ☹
  – Well funded and entrenched interests will fight to keep the status quo and obfuscate the issues
  – Massive problem requiring reforming beliefs, habits, and agendas to be successful

Thank You

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• Janice Nocvin
• Charity Scott, J.D., M.S.C.M.
The Relationship Between the Built Environment & Birth weight in Central Durham, NC

*Duke University, Children’s Environmental Health Initiative*

Rebecca Ouyang, Student; Martha Keating and Pamela Maxson, Faculty Mentors

**Abstract:**
This project seeks to investigate the built environment and its relationship to low birth weight in Central Durham, North Carolina. We examined 17,000 tax parcels in 22 central Durham neighborhoods on eight domains: nuisances, housing damage, property characteristics, security measures, crime level, amenities, tenure status and vacancy. Using 2005-2007 birth data (N=2679) from the North Carolina Detailed Birth Record, we explored the effects of the built environment on birth weight after controlling for individual maternal risk factors. Poor built environment was linked to lower birth weight. Interventions targeted at breaking the cycle of low weight can be implemented at the country, neighborhood and individual levels.
**Neighborhood Quality**

- Traditional measures of neighborhood quality
  - Social and demographic data from US Census
    - i.e., rates of poverty, unemployment, homeownership, education, % minority
- Built environment
  - Physical conditions of the home, buildings, and spaces, created or modified by people, including schools, workplaces, parks/recreation areas, roads
  - Shapes physical and social environments

**How BE can affect Birth Weight**

- Three main physiological pathways by which BE can affect birth weight
  - Inflammatory
  - Immune
  - Stress
- Effects of chronic neighborhood stress may increase the risk of low birth weight (<2500 grams)

**Cycle of Disadvantage and Disability**

- Potential Outcomes
  - Neurodevelopmental disabilities
  - Child abuse
  - Foster care placement
  - Newborn Infant
    - Preterm/LBW
    - FAS
- Risk Factors
  - Infant with increased needs
    - Medical needs
    - Developmental needs
    - Increased irritability
  - Mother under stress
    - Increased demands
    - Lack of supports
    - Substance abuse
- Environment
  - Poverty
  - Poor community supports
  - Poor health services
  - Inadequate academic services
- Self Worth
  - Despair
  - Substance abuse
  - Promiscuity
- Pregnancy
  - Poor prenatal care
  - Tobacco, alcohol and drug exposure
  - Risk of STDs/HIV

**Research Questions**

- What aspects of neighborhood quality affect birth weight?
- How can we break the low birth weight cycle through interventions aimed at improving neighborhood quality and increasing resiliency in mothers?
Birth Data

- Detailed Birth Record (DBR) collected by North Carolina State Center for Health Statistics (5CHS)
- N=2068, Mean=3542.57 grams
- Restrictions:
  - 2005-2007 births within project area
  - No congenital anomalies
  - No alcohol use
  - Maternal age between 15-44
  - Birth weight ≥ 400 grams
  - Gestational age ≥ 36 weeks
  - Non-Hispanic white, Non-Hispanic black, and Hispanic

Multiple Regression Results

- Significant results (p<0.05) noted by orange box
- Visible physical disorder
- Nutrients
- Housing damage
- Property damage
- Residential stability
- Tenure
- Vacancy
- Non-significant results
- Crime
- Security measures
- Amenities

Breaking the Cycle

- County
  - Zoning changes
  - Planning - amenities, transportation
  - Raise housing quality standards
- Neighborhood
  - Buying of dilapidated houses
  - Community activism - neighborhood watch
- Individual
  - Clinical - identify high-risk women
  - Increasing resiliency

Neighborhood Level Intervention

- Quality of Life Durham
  - Empowers community members to create positive changes in their neighborhoods
  - Housing Committee identifies current housing conditions and assists in the planning of future development in the area
- Self Help Credit Union
  - Helps borrowers to build wealth through ownership of a home or business
  - Strengthens underserved communities by financing nonprofits, childcare centers, community health facilities, etc.
Individual Level Intervention

- Individual
  - Clinical
    - Increased prenatal care
    - Identifying high-risk women through depression screening
  - Increasing resilience
    - Familial and social support
    - Increase care coordination within the healthcare system
    - Centering

Conclusions

- Built environment matters and affects birth weight
- Traditional measures of neighborhood quality (crime level, home ownership rates) do not provide a comprehensive picture of the neighborhood
- Interventions can be implemented at the county, neighborhood, and individual level to break the cycle.

Acknowledgments

- Southeast Pediatric Environmental Health Specialty Unit, Emory University
- Institute for the Study of Disadvantage and Disability
- Children’s Environmental Health Initiative
- EPA award RD-83329201-0
- Pamela Maxson
- Martha Keating
“Greening” School Buildings in Disadvantaged Communities

Georgia Institute of Technology, Dept. of Architecture

Selen Okcu, Student; Erica Ryherd and Charlene Bayer, Faculty Mentors

Abstract:
The “Green” building movement centers around designing buildings that are more sustainable in order to decrease energy consumption, minimize environmental impact, and create healthier spaces for occupants. Schools are a particular focus of “green” efforts, in part because of the dramatic impact the indoor environmental has on student learning and health. Although limited research efforts have been conducted to quantify the effect of various green technologies on student outcomes, the impact of green building technologies on student and teacher outcomes remains unclear. We are developing a database that compiles, summarizes, and synthesizes existing findings to provide recommendations for future actions. Our work includes a focus on socially and economically disadvantaged children. We have partnered with the Knowledge Is Power Program (KIPP), a national network of public K-12 schools serving disadvantaged middle school students. Over 90% of KIPP students are African American or Hispanic/Latino, and more than 80% of KIPP students are eligible for the federal free and reduced-price meals program. Unfortunately, many of the Atlanta KIPP schools are older buildings in major disrepair. We are working with the KIPP school system to make informed design decisions on methods to create “greener” and healthier schools for students and teachers at minimum costs. The result of this project will be a greater understanding of the impact of emerging green technologies on student health and learning development, including strategies for addressing current challenges.

Goals of the Study
We are working with the KIPP school system to make informed design decisions on methods to create “greener” and healthier schools for students and teachers. The result of this project will be a greater understanding of the impact of emerging green technologies on student health and learning development, including strategies for addressing current challenges.
**KIPP Schools**

**Mission:** KIPP, Knowledge Is Power Program is on a mission to help students who live in neighborhoods troubled by illiteracy, drug abuse, broken homes, gangs, and juvenile crime develop academic skills, intellectual habits.

- founded in Houston, TX in 1994
- started by two teachers in a single classroom
- operates as a charter school
- majority of KIPP schools (>85%) are middle schools
- serves predominantly low-income and minority children

According to 2008 KIPP report card results, over 95% of KIPP students are African American or Hispanic/Latino, and more than 80% of KIPP students are eligible for the federal free and reduced-price meals program.

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**KIPP Schools**

According to 2008 KIPP reports, across the country there are:

- 66 KIPP schools
- 17,000 KIPP students
- 1200 KIPP teachers

According to estimations, by 2011 there will be:

- 100 KIPP schools
- 25,000 KIPP students
- 1,700 KIPP teachers

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**Disadvantaged Students and Achievement Gap**

Nationwide, low-income students and students of color perform, on average, below their peers.

- **FACT #1:** Low income students remain 20 to 30 points behind students not eligible for free and reduced lunch.

- **FACT #2:** It is known that the 10 point achievement gap equates to roughly year’s worth learning for students.
Causes of Achievement Gap

- Self perception
- Goal orientation
- Financial limitations
  - Poor education strategies adopted by schools
  - Minority group require additional investment (i.e. intensive teacher training, "remedial programs")
- Parental involvement
  - (i.e. assistance from a parent with homework)
  - Non-English speaking parents
  - Lacking non-financial assets (i.e. educational, social, intellectual knowledge)

Closing the Achievement Gaps in KIPP Schools

Dedicated KIPP school programs:

"Students in KIPP schools need more time and lots of hard work, and we do whatever it takes to help students learn."

—KIPP Academy Houston administrator.

Distribution of Low Income Students

There has been constant increase in the number of low income students in the U.S. Public schools since 1960s. Particularly in the South the number of disadvantaged students has always been higher!

Physical Conditions of U.S. Schools

- In 1992, U.S. public school buildings was 42 years old (in average)
- According to GAO report,
  - 1/3 of the U.S. schools need extensive repair/replacement
  - Nationwide 14 million students studying in 15,000 schools are under high risk
- About 60% of the U.S. schools need at least one building feature to be repaired (i.e. heating, ventilating, plumbing, roof, exterior wall).
- Nationwide 26 million students attend schools with major problems

<table>
<thead>
<tr>
<th>Environmental condition</th>
<th>Number of Schools</th>
<th>Number of students affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting</td>
<td>12,000</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Heating</td>
<td>15,000</td>
<td>1,788,000</td>
</tr>
<tr>
<td>Ventilation</td>
<td>21,000</td>
<td>1,039,000</td>
</tr>
<tr>
<td>Indoor air quality</td>
<td>15,000</td>
<td>2,363,000</td>
</tr>
<tr>
<td>Acoustics for noise control</td>
<td>21,000</td>
<td>1,014,000</td>
</tr>
<tr>
<td>Physical security</td>
<td>10,000</td>
<td>1,000,000</td>
</tr>
</tbody>
</table>
School Expenditures

Deferring maintenance and repair expenditures from year to year declines physical condition of U.S. schools. After 40 years, a school building begins rapid deterioration, and after 60 years most schools are abandoned.

* Hawaii had the highest average annual expenditure at $934 per student. Conversely, the state with the lowest average annual expenditure spent $37 per student.

Physical Conditions of U.S. Schools

The condition of building features in schools with the highest concentration of poverty are less than adequate compared to schools with the lowest concentration of poverty.

National Statistics and Student Health (Asthma)

According to CDC report.

FACT#1: In 2007, 5.6 million school-aged children and youth were reported to currently have asthma; and 2.9 million had an asthma episode or attack within the previous year.

FACT#2: Asthma is one of the leading causes of school absenteeism. In 2003, an estimated 12.8 million school days were missed due to asthma.

FACT#3: Asthma is the third-ranking cause of hospitalization among children under 15. The estimated cost of treating asthma in those under 18 is $3.2 billion per year.

National Statistics and Student Health (Hearing Loss)

Another CDC study surveyed 6,000 children and adolescents in Atlanta and found:

- 15% of the children had hearing loss at 16dB;
- 7% had low frequency hearing loss; 13% had high frequency loss.
- An estimated 12.5% of children and adolescents aged 6-19 years (approximately 5.2 million) have suffered permanent damage to their hearing from excessive exposure to noise.
Believes Towards Green Schools

According to "Green Building Market Barometer" conducted by Turner Construction Company, 70% of the 665 executives such as building owners, developers, architects, consultants and school administration believe that green buildings enhance student performance and the ability of school districts to retain teachers.

Green School Research
Impact of overall physical school condition on student outcomes

Studies found that student achievement was higher in schools renovated over the past 10 years (Mannell 1999) in the newer schools (Bowers and Rother 1987; Opper 1992) and in schools with better physical conditions based on student perceptions and Commonwealth Assessment of Physical Environment (Dong 1994; Carle 1972)

Green School Research
Impact of school lighting conditions on student outcomes

The amount of knowledge about the effect of lighting on school children's performance remains limited. However, a comprehensive study by Heschong Mahone Group (1999) found that students in the classrooms with more daylighting and with greater window area processed faster on math and reading tests.

Green School Research
Impact of school lighting conditions on student outcomes

Growing body of evidence suggests that lighting may play an important non-visual role in human health and well-being.

- Improved student behavior (i.e., less nervous, attention to teacher) due to full-spectrum lighting compared to cool-white fluorescent lighting (standard lighting) (Oren 1976).

- Fewer dental cavities, better attendance, achievement, growth and development due to full-spectrum fluorescent lamps with ultraviolet supplements compared to students under the high-pressure sodium vapor lamps, cool-white fluorescent lamps (McHale 1986).
Green School Research

Impact of school acoustic conditions on student outcomes

Sufficient scientific evidence consistently indicates the inverse association between excessive noise levels in schools and student outcomes.

Student achievement outcomes associated with noise
- Reading problems due to airplane noise (Kemper et al., 2002, Hemenway et al., 2001)
- Language acquisition due to chronic noise exposure (Malone et al., 1987)
- Cognitive deficits (Hemenway et al., 2000)
- Student engagement and loss in teaching time (Kemper et al., 2001)
- Intellectual performance (Owens and Owens, 1983)

Student health and wellbeing
- Raised blood pressure and feeling of helplessness (Richards et al., 1992)

Green School Research

Impact of indoor air quality conditions on student outcomes

A growing body of evidence suggests that student absenteeism (Svedelek, 2004)
- Risk of asthma (Phipatanakul, 1993; Novak et al., 1992)
- Test scores (Herger et al., 2003)
- May also be affected by poor indoor air quality (low ventilation rates, high concentration of pollutants as well as humidity and temperature).

Lessons Learned

Blue Mountain Union School POE Study:

Diagnosed Problem:
- Improper use of the HVAC system:

Recommendations from the consultant:
- Restore the ventilation system to its original design
- Regular HVAC system maintenance
- Implement low-cost actions
  - Relocate the bus loading and unloading area.
  - Cess the use of certain cleaning products.
  - Remove carpeting.
  - Move the copy and lamination machines to ventilated sites.
  - Develop a plan to control the moisture

Conclusion

Environmental strategies to improve student outcomes

OVERALL
- Regular assessment of building performance over time

AIR QUALITY
- Effective operation, proper design, regular maintenance of mechanical ventilation system
- Avoid particular sorts of 'fleecy' furnishings and open shelving and to increase the frequency of cleaning because irritants and allergens collect in dust
- Control moisture & molds through well-designed, constructed and maintained building envelopes (moisture resistance and durability of materials)
- Control temperature and relative humidity
References:


Conclusions

And

Meeting Summary
Children living in circumstances of social and economic disadvantage are at high risk for experiencing health problems caused or exacerbated by environmental factors. They are not only vulnerable to adverse chemical and physical factors in their environment but often become trapped in the cycle of environmental health disparities due to low parental health literacy, limited social capital, and a lack of access to comprehensive healthcare and appropriate educational services. They will only be able to escape that cycle when children’s environmental health becomes a priority and resources, energy and creativity are amassed and allocated to address environmental health concerns. Such investment may seem unlikely, given the current economic realities. However, not investing in children’s environmental health will prove costlier in the long run.

Break the Cycle is a sustainable, cost-effective catalyst for increasing academic interest in issues relating to children’s environmental health. The project’s emphasis on incorporating information about environmental health issues and environmental health disparities into college curricula encourages students and faculty to embrace a broader, more holistic understanding of children’s environmental health and environmental justice. Additionally, Break the Cycle affords academic mentors committed to issues of environmental justice with the opportunity to inform, guide, and inspire the next generation of professionals who will face the challenge of finding creative solutions to environmental health dilemmas. By helping shape such future leaders, SE PEHSU furthers the goal of breaking the cycle of children’s environmental health disparities once and for all.

This project, Break the Cycle 5, provided eight student researchers interested in children’s environmental health with the opportunity to develop their research skills and with a platform from which they could disseminate their findings nationally and internationally to interested healthcare providers, academicians, policy-makers, and fellow students.

All eight research projects provide important information that adds to the current understanding of how children are affected by adverse environmental factors and how each project highlights opportunities for breaking the cycle of environmental health disparities.
Summary of Break the Cycle Partnerships (2005 – 2010)

University Partners: (13) universities

- Clark Atlanta University, School of Social Work
- Duke University – Children’s Environmental Health Initiative
- Emory University Barton Law Center
- Emory University School of Public Health
- George Washington University School of Medicine & Health Sciences
- Georgia Institute of Technology, Department of Architecture
- Georgia State University Department of Educational Psychology and Special Education
- Georgia State University School of Law
- Mercer University School of Medicine, Department of Community Medicine
- Morehouse School of Medicine, Department of Community Health and Preventive Medicine
- Spelman College, Department of Biology
- University of Florida in Jacksonville, College of Medicine and College of Public Health
- University of North Carolina-Chapel Hill, Gillings School of Global Public Health

Students Mentored: 36

Participants’ fields of study: public health, medicine, law, education, nursing, social work, architecture

Selected Comments from this Break the Cycle Student Researchers:

As a student participant in Break the Cycle 5, I have been able to listen and learn about other environmental health research topics that need more attention brought to them. It has been motivating to participate in the conference calls because the other students, faculty mentors, and the BTC staff have been inspiring; displaying a genuine desire for improving public health in communities. In addition, I have gained an appreciation for county health departments and other institutions that seek to better community health by equipping populations with the tools necessary to break the cycle of their negative health behaviors. It has been a worthwhile experience learning about mercury exposure in women of childbearing age and has impacted me to be mindful of it in my own life for the future. - Victoria Chau

My passion has always been social work. My career goal to be an effective social worker who understands and is able to address the critical issues and needs of people from all walks of life. The goal of social work is to promote social justice. This Break the Cycle Project has made me acknowledge that I must promote not only social justice but environmental justice as well. I may work with a client who is enduring the ill wills of life, but it is crucial that I recognize the environmental component that plays a role in his or her existence. Prior to researching environmental health disparities, I had no idea the extent in which the built environment has on the health of individuals, specifically children. I have learned a great deal from being a participant in the Break the Cycle Project that will enable me to be in the forefront continuously fighting for social justice and environmental justice. - Shava Cureton
The Break the Cycle Project has been a very rewarding experience. This was the first opportunity I had to work on a project of this breadth, but the support I received from the BTC team and staff has been encouraging. I have had the opportunity to integrate my interests in public health and my knowledge of epidemiological approaches to evaluate the impact of environmental health on childhood obesity. I learned about the complex nature of the environmental health disparities cycle. Through the various projects that were conducted this year, I understood further how health outcomes can be approached from different environmental stances. The monthly teleconferences between project participants, faculty, and staff of BTC have been beneficial in promoting constructive criticism, new ideas, and professional relationships. The staff is committed to the project’s mission and makes every effort to ensure that each students experience is academically fulfilling. - Claudia Twum

I was thrilled to have the opportunity to participate in the “Break the Cycle” program. I met Dr. Leslie Rubin at the 2009 National Environmental Public Health Conference in Atlanta, GA and voiced my frustrations in trying to combine my interests in environmental health and health behavior and health education within the formal structure of my MPH program. “Break the Cycle” has allowed me to combine my interests, while networking with other programs at University of North Carolina Chapel Hill. I am grateful to have had the opportunity to form these connections around a topic that interests me and that is relevant to a state-wide healthy homes initiative. As I progress in my program, I hope to maintain the relationships that I have formed through “Break the Cycle” and to seek further professional opportunities to work on children’s environmental health disparities. - Lindsay Herendeen

My involvement in BTC has given me new perspective on the challenges faced in treating environmental health disparities. As I get ready to begin a career in pediatrics, I will most certainly be more aware of my patients’ surroundings and the impact of environmental health on their general well being. I feel confident in my ability to reduce the impact of both environmental and socioeconomic inequities facing my future patients. BTC has also motivated me to get involved in advocacy as an important tool for combating children's health disparities on the level of public health in addition to individualized care. - Zoya Treyster

Working on this Break the Cycle project has expanded my understanding of how the cycle of disadvantage and disability can perpetuate itself when children are born into poor quality environments. From birth, these children are more vulnerable to risk factors that can carry on into their future development, diminishing their resilience and any chances at escaping this pattern of poor health. Since the effects of environmentally driven disparities manifest themselves into a multi-phase cycle, there also exist numerous stages at which interventions can be implemented to break it. In devising recommendations for my project, I learned how interventions can be applied at the individual, neighborhood and county level to combat health disparities. Having worked on this project, I am sure of my future aspirations to pursue a Master’s of Public Health to work at improving the conditions of vulnerable populations. - Rebecca Ouyang

Collaborative and supportive research environment provided by the Break the Cycle Program helped me investigate the significant role of the school physical environment qualities on children’s wellbeing and achievement outcomes. Regular gatherings via conference call meetings enabled knowledge exchange between the participants. Variety of research topics presented, helped me expand my view on different aspects of environmental health disparities. It was always motivating to hear about the supportive feedback from the program directors. - Selen Okeu

I picked my topic last fall on a lark. As part of the Georgia State College of Law's Urban Fellows program, I had been studying about the effects of the built environment on public health, and figured that childhood obesity might be a pertinent topic. I had no idea how pertinent! Shortly after I chose my topic, Michelle Obama made childhood obesity the focus of her public work. From the time I began to research this topic up even until today major new research, news articles, and books have been published on the subject. It has been a great experience working on something so timely and pertinent. One of the struggles a law student faces is the wide range of law that can be practiced. One of my goals in returning to law school has been to practice law I believed in. This definitely fits that category. I have four children, and so am naturally interested in how the law shapes and effects children’s lives. I hope to always devote at least a portion of my practice to working on these types of projects. I also believe heavily in the interdisciplinary environment fostered in the Break the Cycle group, and it has been an honor to work with Professor Charity Scott, whom I greatly admire. Overall, this has been a great experience. I don't think my law school experience would have been complete without it. - Raymond Lindholm
The Pediatric Environmental Health Specialty Units (PEHSU) form a respected network of experts in children's environmental health. The PEHSU were created to ensure that children and communities have access to specialized medical knowledge and resources for children faced with a health risk due to a natural or human-made environmental hazard, usually at no direct cost.

Located throughout the U.S., Canada, and Mexico, PEHSU professionals provide quality telemedical consultation for health professionals, parents, caregivers, and patients. The PEHSU are also dedicated to increasing environmental medicine knowledge among healthcare professionals around children’s environmental health by providing consultation and training. Finally, the PEHSU provide information and resources to school and community groups to help increase the public’s understanding of children's environmental health.

This work is important because children are uniquely vulnerable to environmental toxicants, such as lead, mold, pesticides, and many other sources. Children's environmental health is the study, prevention and treatment of the effects of these toxicants on the health and development of children. It is also important because most healthcare professionals do not receive training to prevent, recognize, manage and treat environmentally-related conditions.

**Pediatric Environmental Health Specialty Unit Locations:**

<table>
<thead>
<tr>
<th>PEHSU Sites</th>
<th>EPA Regions</th>
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<tbody>
<tr>
<td>1 – Harvard Medical School - Cambridge Hospital &amp; Children’s Hospital Boston</td>
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<tr>
<td>2 - Mount Sinai School of Medicine - Mount Sinai Medical Center</td>
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<td>3 - George Washington University Medical Center and Children’s National Medical Center</td>
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<td>4 - Emory University Department of Pediatrics</td>
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<td>5 - University of Illinois at Chicago and Stroger Hospital of Cook County</td>
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<td>6 - University of Texas Health Science Center at Tyler</td>
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<td>7 - University of Missouri-Kansas City School of Medicine</td>
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<td>8 - University of Colorado Health Sciences Center - National Jewish Medical and Research Center</td>
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<td>9 - University California at San Francisco and University of California at Irvine</td>
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<tr>
<td>10 - University of Washington: Occupational and Environmental Medicine Program, Department of Pediatrics</td>
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**Canada - University of Alberta and Stollery Children's Hospital**

**Mexico - National Institute of Public Health (Instituto Nacional de Salud Publica)**

The Southeast Pediatric Environmental Health Specialty Unit at Emory University provides:

1-Techical assistance to agencies, health care providers, and concerned individuals
2-Health education (e.g. speaking engagements)
3-Individual consultation and referral to clinical pediatric environmental health services
4-Support for and participation in research
5-Educational materials

Our region: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee

We can be contacted at [www.sph.emory.edu/PEHSU](http://www.sph.emory.edu/PEHSU) or toll free at 1-877-337-3478