Break The Cycle

Break the Cycle of Environmental Health Disparities in Vulnerable Children

A Monograph of

Southeast Pediatric Environmental Health Specialty Unit
at Emory University

Funded by

Environmental Protection Agency, Region IV
Children's Health Protection

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PREFACE

On May 2, 2008, the Southeast Pediatric Environmental Health Specialty Unit (SE PEHSU) at Emory University convened a *Break the Cycle* symposium at the Rollins School of Public Health to showcase six student research projects focusing on the environmental health disparities of children who are vulnerable as a result of social and economic disadvantage. The SE PEHSU is pleased to publish this monograph to introduce the students' work to a wider audience, raise interest in the related peer-reviewed journal articles that will be published in 2009, and inspire additional research related to children's environmental health.

The studies in this monograph focus on a wide range of health concerns and environmental justice issues, including: pesticide exposure, asthma, childhood obesity, pubertal development, and student awareness of environmental health disparities and related career opportunities. The designs and methodologies of the students vary significantly and reflect a diversity of styles and disciplines. All underscore the need for further environmental health disparity research that can be used to inform public policy, public health initiatives, and the training of environmental health leaders in a wide range of academic and professional disciplines.

We would like to thank the Region IV Office of the Environmental Protection Agency for funding the *Break the Cycle* project and are particularly grateful to **Wayne Garfinkel** for his encouragement and ongoing assistance. We were fortunate to have the support of **Beverly Houston Banister,** Director of the Air, Pesticides and Toxics Management Division at the Environmental Protection Agency (EPA) Region 4 office in Atlanta, Georgia. We also wish to acknowledge the critical contributions of our partnering agency, the Institute for the Study of Disadvantage and Disability (ISDD), led by its President and Founder, **Leslie Rubin, MD**.

Special thanks go to the faculty and students who participated so enthusiastically in the project. Their work contributes to the larger, multidisciplinary effort to improve the health and quality of life of vulnerable children.

We would also like to thank **Camara P. Jones MD, MPH, PhD**, Research Director on Social Determinants of Health at the National Center for Chronic Disease Prevention and Health Promotion of the Centers for Disease Control and Prevention for her inspirational keynote address.

Finally, we would like to thank all the children and families who participated in the *Break the Cycle* research projects. None of the studies would have been possible without their willingness to share their thoughts and experiences.

The SE PEHSU has already begun work on our next *Break the Cycle* project which will culminate in a conference to be held at the Centers for Disease Control and Prevention in Atlanta in September, 2009. In doing so, we aim to further the knowledge base related to environmental health disparities, raise awareness of environmental justice issues, and cultivate future leaders. Through this and other endeavors, we hope to one day make the study of environmental health disparities a study of the past.

The Southeast Pediatric Environmental Health Specialty Unit Team

INTRODUCTION

Environmental Influences on Children's Health

A myriad of environmental factors interact in complex ways to affect children's health and wellbeing. Adverse environmental factors can cause, exacerbate, or complicate serious childhood health problems such as asthma, obesity, high blood pressure, diabetes, asthma, and neurodevelopmental conditions such as attention-deficit-hyperactivity disorder. Unfortunately, many of these environmental factors that operate through direct and indirect mechanisms are not clearly understood. This must change if we are to help children live longer, healthier, happier and successful lives.

Efforts to promote children's health and reduce or eliminate childhood health problems must incorporate an understanding, not only of the how the chemical toxins cause damage to organ systems, but also how physical spaces and structures influence the health, growth and development of children. Home and school environments, open spaces, and community infrastructure help shape children's diets and influence levels of physical activity. They also influence children's interactions with other people and the natural world around them. The condition, design, and location of homes and schools also have a significant impact the exposure of children to toxicants and other physical hazards. Thus, children's health can be enhanced by the proper design, maintenance, and management of buildings and others spaces that children inhabit and frequent.

Disease prevention and health enhancement activities targeting children must also reflect the realties of their physiology and their behavior. For example, activities focusing on toxicant exposure must recognize the fact that children are especially vulnerable to environmental toxicants. Compared with adults, children absorb more environmental toxins through the skin because of their greater surface-area-to-body-mass ratio. Their large air intake relative to body size and closer proximity to the ground increase their vulnerability to air pollutants such as car exhaust. They have a greater tendency to touch and ingest potentially toxic objects they found in their environment. Because of their faster growth and a higher metabolic rate, they are more likely to incorporate such toxins into their maturing organ systems and suffer health consequences that may only become evident much later in life. For all these reasons, children require special attention and cannot be treated as if they are simply small adults.

Effective child health and wellness promotion also requires a realistic assessment of how psychosocial, political, cultural, and economic factors impact children's access to healthcare and other resources. Children who grow up in circumstances of social and economic disadvantage are especially likely to experience health problems because of where they live, learn, and play. They are also less likely to have their healthcare and educational needs met. As a result, they are prone to become trapped in a multi-generational cycle of environmental health disparities that interferes with their ability to reach their full potential.

The PEHSU Network

Assessing and responding to children's environmental health concerns requires specialized, multidisciplinary expertise. Recognizing this, the Agency for Toxic Substances and Disease Registry (ATSDR) and the United States Environmental Protection Agency (EPA) established the Pediatric

Environmental Health Specialty Units (PEHSU) Program in 1998. Administered by the Association of Occupational and Environmental Clinics (AOEC), this program is comprised of 12 university-based medical teams based in the United States, Canada, and Mexico that provide consultation, education, and professional training related to children's environmental health. (Figure 1.)

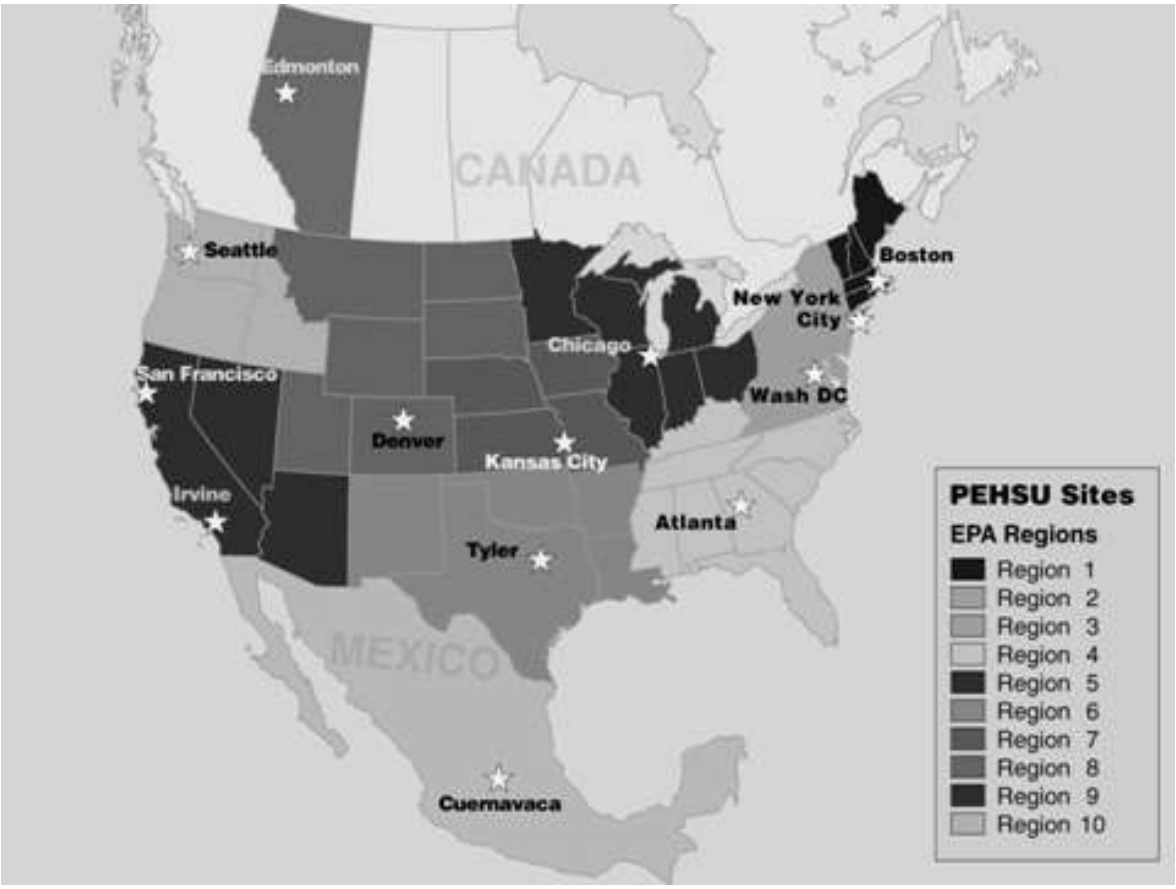


Figure 1: Map of PEHSU Network Sites

The PEHSUs help ensure that children, families, healthcare professionals, schools, and communities have access to resources and quality information about natural or human-made environmental hazards that adversely affect children's health and development.

The Region IV PEHSU at Emory University

The Southeast (SE) PEHSU was established at Emory University in 2000 to serve children, families, healthcare providers, and communities throughout Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee. Since then, it has advanced its network and impact through affiliations with Morehouse School of Medicine, the Institute for the Study of Disadvantage and Disability (ISDD), and various community groups.

The primary goals of the SE PEHSU are: 1) improving the health of children with respect to environmental exposures and 2) informing families, communities, and health care providers about environmental hazards, their effects, and practical ways to protect children's health.
To that end, the SE PEHSU:

- Provides consultation and technical assistance to agencies, healthcare providers, and concerned members of the community
- Provides direct pediatric environmental healthcare services, including those offered through toxicology, developmental, and asthma clinics
- Refers children with complex needs for appropriate evaluation and treatment
- Conducts environmental health education activities
- Nurtures students in Environmental Health, Pediatrics, Nursing and other academic and professional disciplines
- Supports and participate in research related to children's environmental health concerns
- Develops relevant educational materials

The SE PEHSU core team is comprised of specialists in medical toxicology, developmental disabilities, environmental epidemiology, and education. Partners at Emory University provide additional services spanning the full range of pediatric specialties. Since its founding, it has established itself as a center for quality pediatric environmental health services, professional education, and research. Its accomplishments include:

- Providing training to more than 2600 professionals representing a variety of disciplines, including medicine, nursing, public health, law, psychology, and education
- Participating in approximately 60 local, state, and national conferences
- Publishing articles on children's environmental health issues in peer-reviewed journals
- Joining the Southeast Diesel Collaborative, which works to improve air quality by promoting strategies to reduce diesel emissions
- Contributing to the ground-breaking *Clinical Recommendations Regarding Return of Children to Areas Impacted by Flooding and/or Hurricanes*, which were endorsed by the American Academy of Pediatrics (AAP) and distributed to all pediatricians practicing in areas impacted by Hurricane Katrina
- Collaborating with colleagues in Santiago, Chile on the development of a replicable international PEHSU model
- Receiving the 2005 Children's Environmental Health Excellence Award from the EPA for work on Vision 2020, a community-based project based in Anniston, Alabama to address the health and developmental problems of children from communities contaminated by lead and polychlorinated biphenyls (PCBs).
- Developing and editing *Safe and Healthy School Environments*, the first comprehensive text addressing the gamut of school environmental health issues and concerns

The Cycle of Environmental Health Disparities Model

Nurturing, resource-rich environments promote optimal health and development. Children living in circumstances of social and economic disadvantage often lack adequate care and nurturing. Instead, they tend to live in unsafe and unsupportive environments that place them at increased risk for

environmental factors that result in poor health, developmental delays, impaired learning, and other difficulties that reduce their overall quality of life and limit opportunities for success in adulthood.

The experiences of the SE PEHSU working on the Vision 2020 project in Anniston, Alabama underscored the importance of adopting a comprehensive approach to children environmental health that includes recognition of how environmental health disparities are shaped by social and economic factors and perpetuated over time. Understanding the complexities of the environmental factors involved was further heightened after ISDD launched a project in 2005 to promote research and information dissemination related to health disparities experienced by children and families living in circumstances of social and economic disadvantage. The project, known as *Break the Cycle of Disadvantage and Disability*, introduced a holistic model that explained how various social, psychological, and physical factors compounded the challenges faced by individuals with limited resources. It also emphasized the importance of interrupting the cycle of disadvantage and disability that perpetuates such difficulties, both over the course of a lifetime and across generations.

This model helped the SE PEHSU team better identify factors that must be considered when promoting children's environmental health. Moreover, ISDD's *Break the Cycle* project helped the PESHU realize that promoting children's environmental health requires more than the simple recognition of the direct effect of a toxin on the health, growth and development of children. To be effective, it is important to recognize the environment in which the children are more likely to be exposed to the toxins and the populations of children who are particularly vulnerable. These realizations led to the development a conceptual model of the Cycle of Environmental Health Disparities. (Figure 2)

As the model illustrates, children living in families headed by adults with limited education and health literacy, limited income and employment opportunities, and a relative lack of power within their community are at increased risk for experiencing adverse environmental health outcomes. Their experience of social and economic disadvantage often leaves them with few housing options in rural, urban, or suburban communities. They are more likely to live in poorly-maintained older homes and be exposed to indoor toxicants, such as lead paint and mold, as well as other outdoor environmental hazards. They are also more likely to live in communities with limited access to transportation, to grocery stores, green space, and recreational opportunities. Moreover, they are more likely to be exposed to violence within their immediate community.

The increased risk of toxicant exposure, poor nutrition, limited physical activity, abuse, neglect, and stress that are often shaped or exacerbated by environmental conditions, in turn increase children's risk of physical health problems, such as asthma, obesity, hypertension and neurodevelopmental disorders. They may also interact in a complex manner that contributes to and compounds learning disabilities, ADHD, depression, trauma reactions, substance abuse, and behavioral disorders. A lack of access to comprehensive healthcare and appropriate educational services, as well as discrimination, social stigma, and lack of social capital further increase the likelihood that these children will continue to experience adverse health outcomes, even into adulthood.

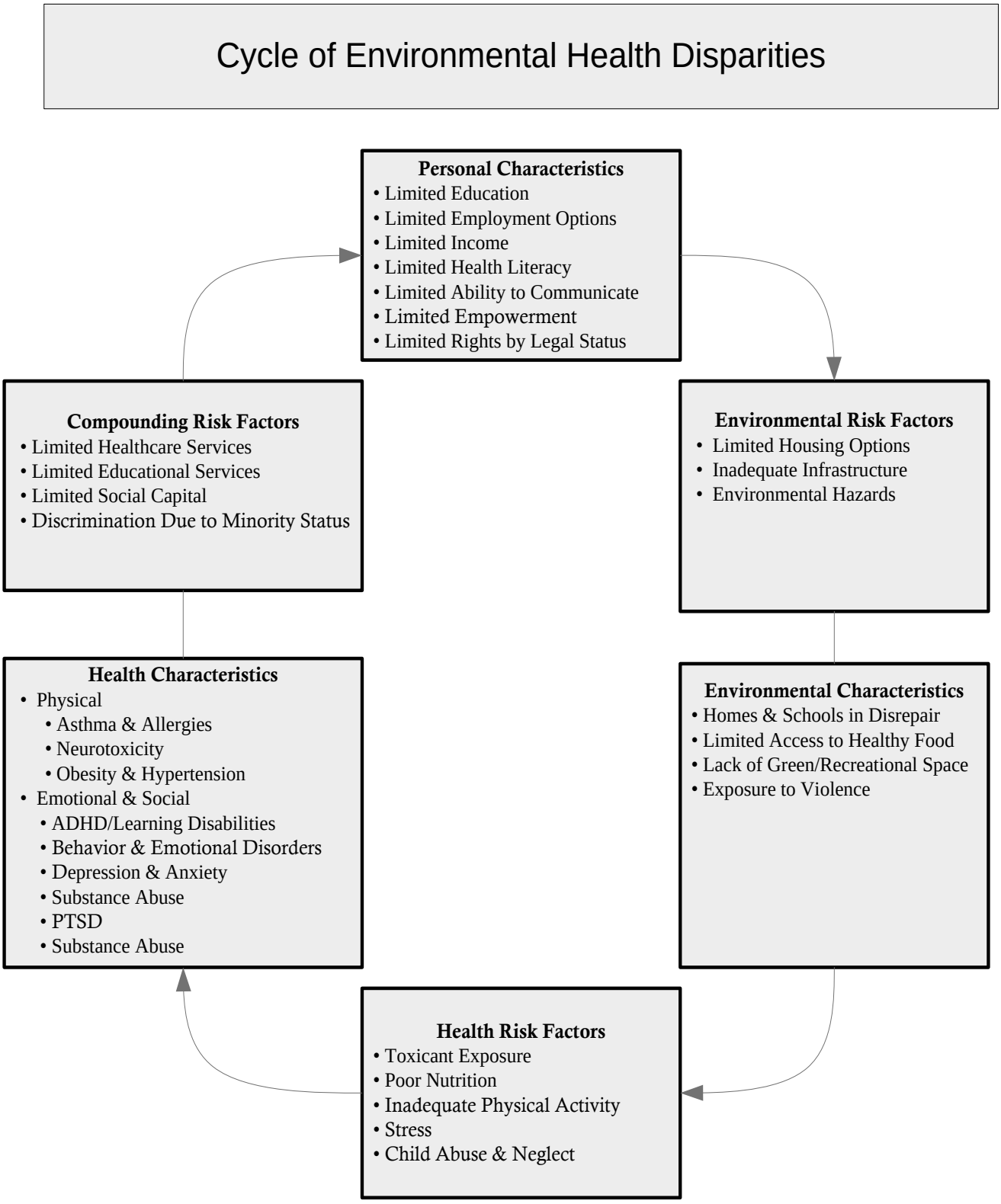


Figure 2: Cycle of Environmental Health Disparities

SE PEHSU's *Break the Cycle of Environmental Health Disparities* Project

The SE PEHSU *Break the Cycle* Project is a collaborative, interdisciplinary pediatric environmental health research and training program that encourages university students supervised by academic mentors to conduct research related to the reduction or prevention of environment-related illness and disability in children living in circumstances of social and economic disadvantage. *Break the Cycle* is designed to:

- Inspire students from a variety of academic disciplines to explore the relationship between the environment and children's health, as well as develop strategies for addressing identified pediatric environmental health challenges
- Promote collaboration among academic leaders at major universities to facilitate creative examination of the issues relating to the impact of environmental factors on children's health and quality of life
- Promote the incorporation of children's environmental health topics into university curricula
- Develop the academic and leadership capacity of professionals within academic and healthcare communities who can, in turn, promote interest in children's environmental health and environmental justice

Students and faculty mentors are recruited from universities throughout the Southeast region. Proposed projects are reviewed for relevance, design, and fit within the project cycle by a committee comprised of the core PEHSU team, representative university faculty, environmental health experts, and students. During the research phase, monthly conference calls are held to track the students' progress and ensure that students and mentors receive sufficient guidance and support.

At the end of each project period, the student researchers are required to present their findings at a symposium sponsored by SE PEHSU and its strategic partners. This symposium not only provides budding scientists, academics and advocates with an opportunity to hone their research presentation skills, but also allows for dissemination of their findings to other scientists and academics as well as healthcare providers, fellow students, advocates and the general public. Each symposium features a nationally-recognized keynote speaker selected for their ability to inspire participants and facilitate relevant discussion. Participants are asked to complete evaluation forms that elicit feedback about the student presentations, as well suggestions and information that can be used to inform planning related to project cycles and symposia. The students are also required to submit formal academic papers to peer-reviewed journals.

At the conclusion of each project cycle, the symposium's proceedings are published in a monograph which is made available to participants, funders, and others who express an interest. The monograph is also made available on the SE PEHSU website (www.sph.emory.edu/PEHSU).

BREAK THE CYCLE OF ENVIRONMENTAL HEALTH DISPARITIES IN VULNERABLE CHILDREN

The SE PEHSU's first *Break the Cycle of Environmental Health Disparities* project cycle was initiated in January 2008 and was built upon ISDD's earlier *Break the Cycle* projects. Faculty with special expertise related to environmental health and justice at 10 universities in EPA Region IV were invited to participate. Seven faculty mentors affiliated with five different academic institutions were ultimately recruited. They, in turn, encouraged their students to submit research proposals. Six projects involving five undergraduate and four graduate students were approved for presentation and publication.

The presentations compiled in this monograph were presented on May 2, 2008 before an audience of environmental health professionals, professors, students, and community leaders who convened at the Rollins School of Public Health at Emory University, Atlanta, Georgia. The results of the six *Break the Cycle* research projects will be published in the Fall 2009 issue of the *International Journal of Child and Adolescent Health*.

Feedback obtained from symposium attendees confirmed that interest in environmental health spans a variety of disciplines, including medicine, nursing, social work, education, public administration, and the natural sciences. Moreover, a number of symposium participants used the symposium evaluation form to suggest potential strategies and partners that could further enhance the project's reach and efficacy.

Additionally, participating faculty reported that the framework and funding provided through *Break the Cycle* provided them with a value opportunity to mentor budding environmental health researchers. At the time of this writing, three faculty mentors have already expressed an interest in working with students on future *Break the Cycle* projects.

Figure 3: *Break the Cycle* Faculty (2008)

STUDENT PROJECTS

Abstracts
Presentations
References

1. Disparities in Girls' Pubertal Development

Amparo Gonzalez-Feliciano, BS

Mentors: Michele Marcus, PhD and Mildred Maisonet, PhD
Rollins School of Public Health, Emory University

The age at which girls experience their first menstrual period, also known as menarche, is influenced by genetic and environmental factors. In the United States and in Europe, age at menarche has declined over time. This is of concern because earlier age at menarche has been associated with increased risk of breast cancer and adverse reproductive outcomes. Current data indicate that black girls attain menarche earlier than white girls, and overweight and obese girls attain menarche earlier than their normal weight peers. However, data from earlier time periods reveal that the racial difference in age at menarche is a recent phenomenon. Therefore, it is likely to be due to environmental factors. Using data from NHES II and III, NHANES III, and NHANES 2003-2006 we explored the associations between BMI and menarche among black girls and among white girls in each of the time periods. Using probit analyses, we observed that for all three survey periods, higher BMI was associated with a younger median age at menarche. However, there appeared to be a threshold above which increasing BMI was not associated with additional decreases in age at menarche. Race-specific analyses revealed a steeper decline in age at menarche with increasing BMI for black girls than for white girls. This apparent interaction has not been previously reported. Possible mechanisms for race-specific differences in the relationship between BMI and age at menarche should be explored.

Disparities in Girls' Pubertal Development

Amparo González-Feliciano

Break the Cycle III Conference

May 2, 2008

Background

- Multiple studies on pubertal development
- Many have reported global trend towards decrease of age of pubertal onset
- In the United States
  - Decrease of age of pubertal onset observed
  - Also, differences on timing of puberty onset among races/ethnicities

Public Health Implications of Early Pubertal Development

- Early puberty has been implicated with:
  - Early sexual debut
  - Incidence of conduct and behavior disorders during adolescence
  - Metabolic syndrome
  - Reproductive tract cancers
    - Early menarche – breast cancer

» From : Golub et.al. *Pediatrics* 2008; 121 (3):S218-S230

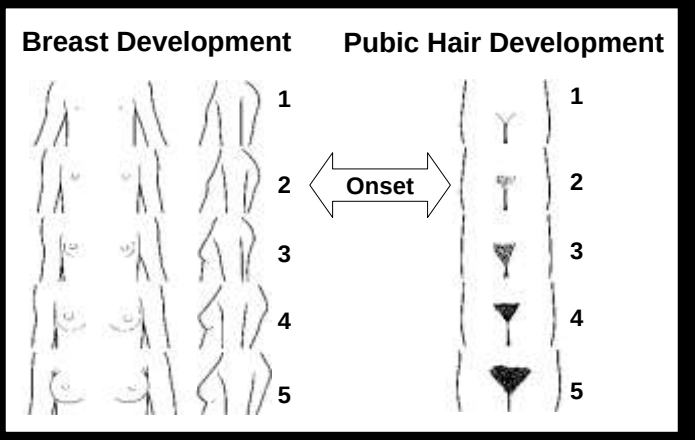
Markers of Pubertal Development

In girls:

- Secondary Sexual Characteristics
  - Breast Development
  - Pubic Hair Development

} Assessed using **Tanner Stages**

Tanner Stages



Adapted from: http://www.ncbi.nlm.nlm.nih.gov/books/bv.fcgi?rid=endocrin.box.1059

Markers of Pubertal Development

In girls:

- Secondary Sexual Characteristics
  - Breast Development
  - Pubic Hair Development
- Menses
  - Reported age at first menses (menarche)
  - Status quo

Review of Literature: Secondary Sexual Characteristics

Study from the Pediatric Research in Office Settings Network (PROS)

- Assessed secondary sexual characteristics and menses
- Girls seen in office practices
  - 17,077 girls
  - Age range: 3 -12 years of age
  - 9.6% Black , 90.4% White
- Collected from July 1992 – September 1993
  - (Herman-Giddens et. al. *Pediatrics* 1997; 88 (4):505-512)

Study from the Pediatric Research in Office Settings Network (PROS)

- Age of Onset of Breast Development (B2)
  - Black girls -- 8.87 years
  - White girls -- 9.96 years
- Age of Onset of Pubic Hair Development (PH2)
  - Black girls -- 8.78 years
  - White girls -- 10.51 years

Study from the Pediatric Research in Office Settings Network (PROS)

Landmark paper

- Showed that girls were developing earlier than noted in textbooks and other studies
- Showed a marked difference between races
- Lawson Wilkins Pediatric Endocrine Society proposed new guidelines based of these results
  - Change cut-off age for precocious development
  - Make cut-off values race specific

Study from the Pediatric Research in Office Settings Network (PROS)

Limitation

- Not nationally representative sample
  - Possible that girls with earlier pubertal development might be more prone seek medical attention

Strengths

- Large sample size
- Included girls as young as 3 years of age
- Training of Physicians

NHANES III: 1988-1994

- Wu et.al. (*Pediatrics* 2002; 110 (4): 752-757)
  - Age range: 8 – 16 years of age
  - Age of Onset of Breast Development (B2)
    - Black girls -- 9.5 years
    - White girls --10.3 years
  - Age of Onset of Pubic Hair Development (PH2)
    - Black girls -- 9.5 years
    - White girls -- 10.6 years

PROS & NHANES

- Both studies found slightly different results
  - NHANES showed older ages than PROS
- However, they present similar trends:
  - Puberty onset earlier that previous studies
  - Puberty onset different according to race/ethnicity

Limitations in the Assessment of Secondary Sexual Characteristics

- Difference in assessment
  - Difficult to compare to other studies
    - Previous studies in US
    - Studies in other countries
- Prone to bias
  - Influence of body composition
    - Could lead to overestimation

Review of Literature: Menses

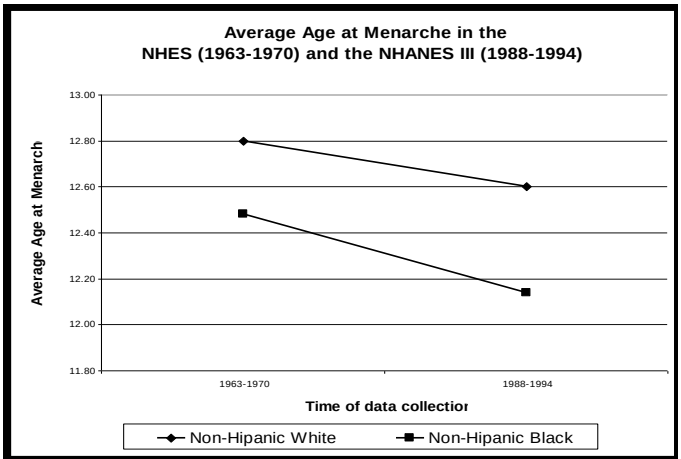
Menses as marker for Girls Pubertal Development

- Assessed in many studies and many populations throughout time
- Easier to compare across studies
  - Less bias
- Biological Significance

NHES II & III vs. NHANES III

- Anderson et.al (*Pediatrics* 2003; 111(4): 844-850)
  - Performed same analysis in both data sets
  - Age Range 10-15 years
  - Menarche*: Status-quo*

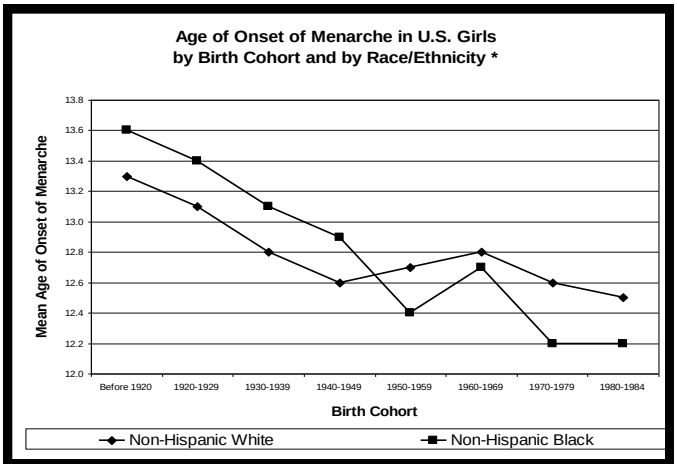
Study	Non-Hispanic **White**	Non-Hispanic **Black**
NHES II & III (1963-1970)	**12.80** (12.73 – 12.87)	**12.48** (12.28 – 12.67)
NHANES III (1988-1994)	**12.60** (12.48 – 12.71)	**12.14** (11.87 – 12.39)



*** Anderson, et.al; *Pediatrics* 2003; 111(4): 844-850**

NHANES: 1999 - 2004

- McDowell et.al. (*J. Adolesc Health* 2007; 40:227-231)
  - 20 years of age or older
  - Divided into birth cohort
  - *Menarche*: self-reported age at first menses



*** McDowell, et.al; *Journal of Adolescent Health* 2007; 40: 8227-231**

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2. Obesity Intervention Strategies and the Built Environment in a Low-income, Minority Population

Kelly Henderson

Mentor: Pamela Maxson, PhD
Children's Environmental Health Initiative, Duke University

The growing trend of childhood obesity has been a leading public health issue in recent years. Many previous childhood obesity interventions have targeted aspects of the school setting without finding significant results. More recently, the literature has suggested that specific environmental characteristics may be influential in determining overweight status. This project aimed to investigate the built environment of central Durham neighborhoods in order to assess food and physical activity environments and how they may influence childhood overweight. A community assessment was conducted using a tool that is supported by an ArcGIS platform. The data suggested that the availability of convenience stores and fast food restaurants dominated the food environment and the park space was limited in size and allocated disproportionately among neighborhoods. The lack of abundant food sources offering healthy options and limited park space and usable sidewalks in the central Durham neighborhoods may influence a child's diet and level of physical activity. This work provides an objective documentation of built environment variables in the Durham urban setting to community leaders, government officials, and physicians in order to address childhood obesity at both a community wide and individual level.

Obesity Intervention Strategies and the Built Environment in Durham, N.C.

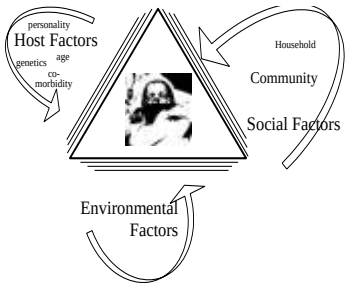
Kelly Henderson

May 2, 2008

Children's Environmental Health Initiative

A research, education, and outreach program committed to fostering environments where all children can prosper.

Southern Center on Environmentally Driven Disparities in Birth Outcomes



Obesity Epidemic for Children

- Growing public health issue
- Severe health-related consequences
- Environmental barriers

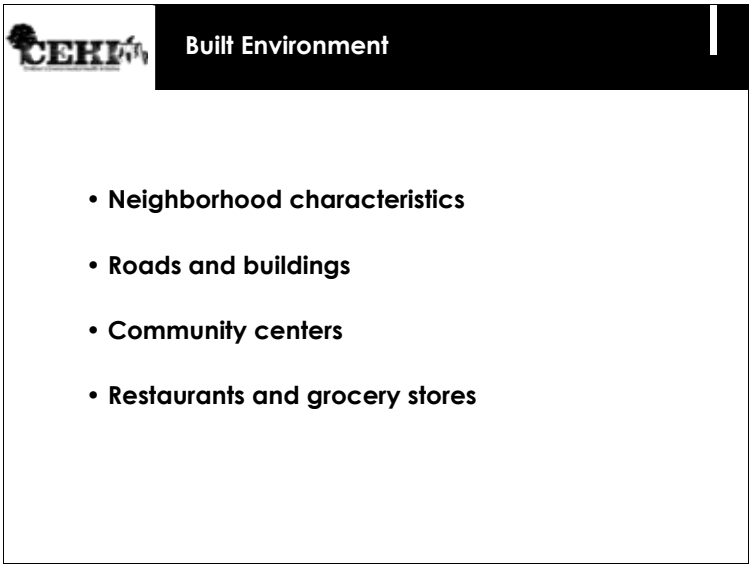
Intervention Strategies

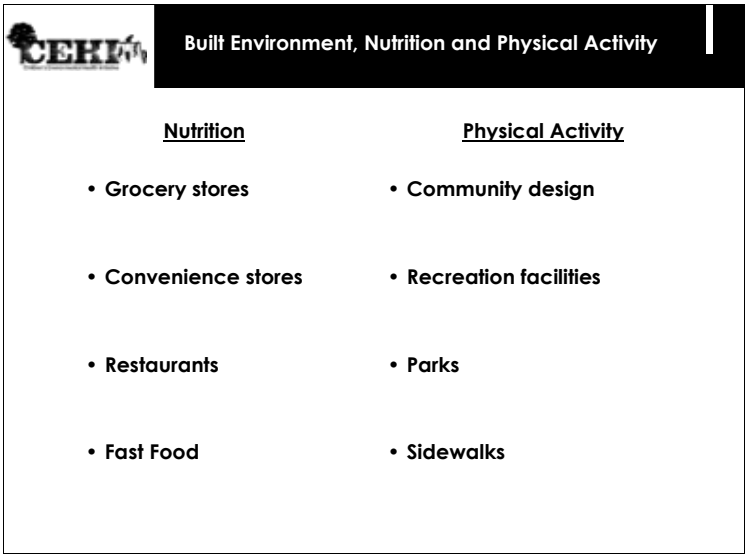
- School-based interventions
  - Improve nutrition
  - Increase physical activity
  - Teach nutrition and exercise

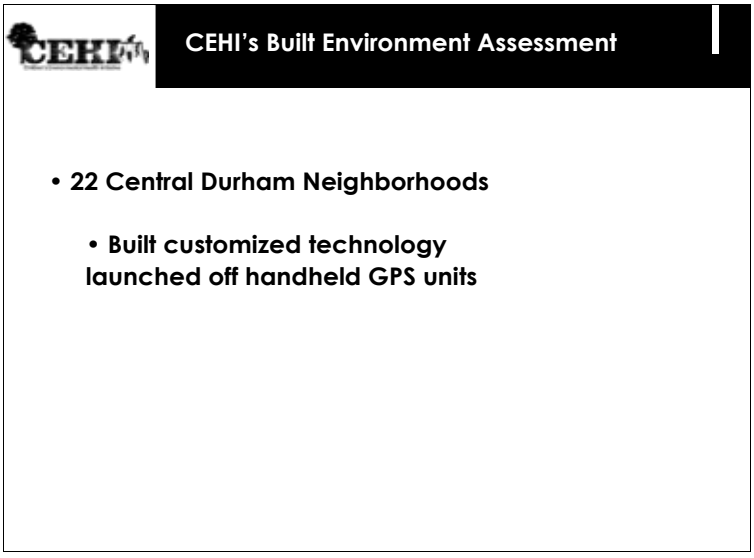
- Community-based interventions
  - Cardiovascular disease
  - Blood pressure

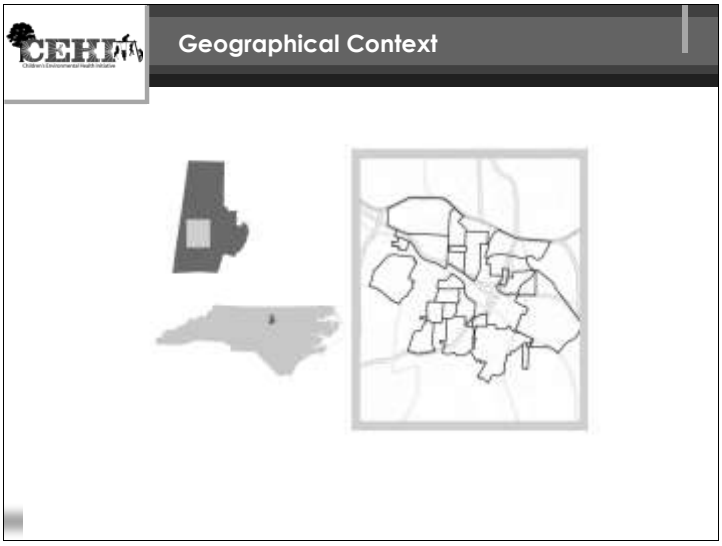
Shape Up Somerville

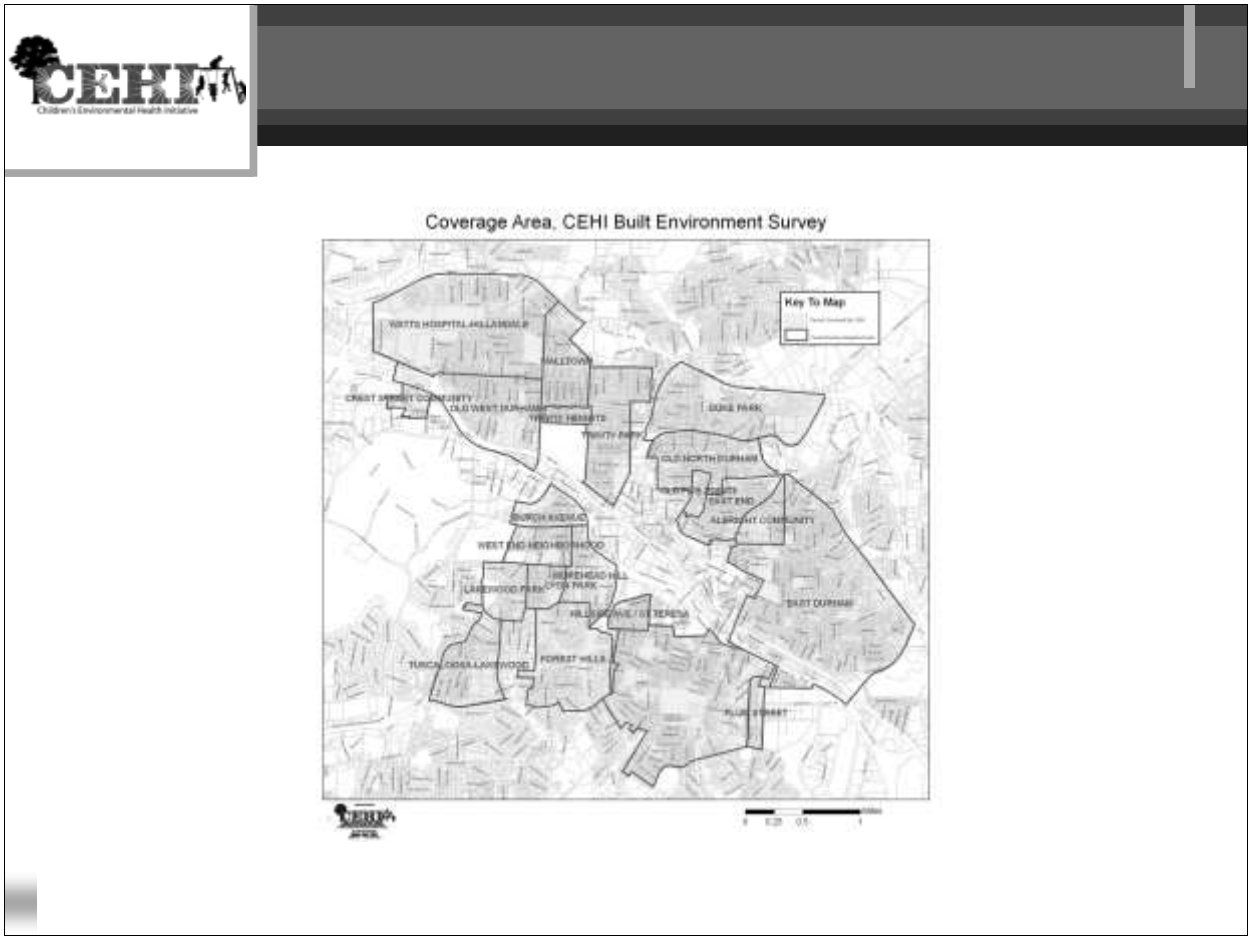
- Community-based environmental change intervention
  - healthy meals
  - physical activity
  - approved restaurants
  - safe routes to school


CEHI
Built Environment
• Neighborhood characteristics
• Roads and buildings
• Community centers
• Restaurants and grocery stores


CEHI
Built Environment, Nutrition and Physical Activity
Nutrition
Physical Activity
• Grocery stores
• Convenience stores
• Restaurants
• Fast Food
• Community design
• Recreation facilities
• Parks
• Sidewalks


CEHI
CEHI's Built Environment Assessment
• 22 Central Durham Neighborhoods
• Built customized technology launched off handheld GPS units


Geographical Context


Coverage Area, CEHI Built Environment Survey
Key To Map

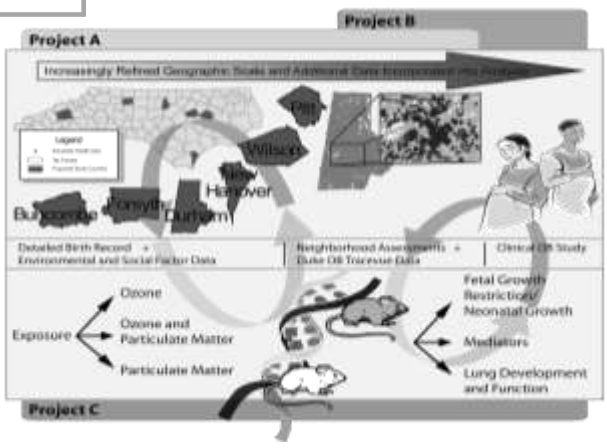
Breaking the Cycle

- Create environments conducive to healthy living
  - Increase access to grocery stores
  - Improve physical activity opportunities
- Community-based approach
  - Develop interventions that are culturally embedded into the community
    - Target churches
- Incorporate GIS-based technology into health care

Acknowledgements

- U.S. Environmental Protection Agency (RD83329301-0)
- Institute for the Study of Disadvantage and Disability
- Southeast Pediatric Environmental Health Specialty Unit, Emory University
- Duke University Office of Research Support
- CEHI – Pamela J. Maxson, Martha Keating, Christopher Fresco, and the Built Environment team

SCEDDBO



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3. Pesticide Exposure in Young Children of Migrant Laborers in South Georgia: A Study in Progress

Rachel Kauffman, BSN

Mentor: Chensheng Alex Lu, PhD
Rollins School of Public Health, Emory University

In this paper we review the current state of knowledge regarding pesticide exposure and neurodevelopment in children and describe a study underway among migrant farmworker children in South Georgia. Growing evidence from animal studies, research on infant, toddler and mother's exposure to pesticides suggest a relationship between pesticide exposure and adverse developmental outcomes. This paper explores methods of exposure measurement, with a focus on biomarkers and current state- of-the-art outcome measures of neurodevelopment. We also explore the challenges of this type of study in migrant farmworker and pediatric populations. Migrant farmworker populations are of particular concern due to higher rates of exposure. We describe four studies contributing to this literature using various types of exposure and outcome measurements. Children are uniquely vulnerable because of their behavior, higher activity levels and faster metabolism. Those living in agricultural areas may be exposed to higher pesticide levels than other children due to pesticides tracked into their homes by household members, by pesticide drift, breast milk, or by playing in nearby fields. Very limited information exists on the effects of chronic or repeated exposure to pesticides among children of farmworkers. Studies such as the one described here will help advance knowledge in the field and help vulnerable populations such as migrant farmworkers and their children.

Pesticide Exposure and Neurocognitive Development in Migrant Farmworker Children of South Georgia

Emory University
Rachel Kauffman, R.N.
Candidate MSN-MPH

Background

- In Georgia, migrant farmworkers harvest approximately 90% of local crops generating more than 300 million USD in the state's number one industry

Farmworkers & Pesticides

- Farmworkers and their families experience increased rates of disease due to use of pesticides.
- Despite improvements in the Worker Protection Standards, many farmworkers do not receive training in pesticide application.
- Between 1992 and 1996 nearly 20% of all hired cropworkers mixed or applied pesticides. Of these, only 50% received training.

Farmworkers & Pesticides

- The Environmental Protection Agency (EPA) estimates that agricultural workers experience 10,000 to 20,000 acute pesticide poisonings annually.
- Farmworkers endure the highest rate of chemical-related illness among any occupational group with a rate of 5.5 cases per 1000. (Bureau of Labor Statistics)

Migrant Farmworker Children & Pesticide Exposure

- Approximately 500,000 children migrate annually with their parents throughout the United States.
- Migrant farmworker children are at an increased risk for pesticide-related illness due to substandard housing conditions, limited training in pesticide handling/exposure by family members and inadequate water and sanitation facilities.

Children & Pesticide Exposure

- Pesticides are thought to pose a considerably higher risk to children due to:
  - behavior (e.g., increased hand-to-mouth activity)
  - potentially longer-term exposure over a working lifetime
  - overall higher activity levels
  - faster metabolism
  - smaller body weight per exposure (Rohlman, 2006).

Children & Pesticide Exposure

- Children living in agricultural areas may be exposed to higher pesticide levels than other children because of pesticides tracked into their homes by household members, by pesticide drift, by breast milk from their farm worker mother, or by playing in nearby fields (Eskanazi, 1999)

Why is this Important?

- Few studies have assessed the extent of children's pesticide exposure, and no studies have examined whether there are adverse health effects of chronic exposure (Eskanazi, 1999)

Why is this Important?

- There is concern about the impact of pesticides as neurotoxicants on the developing nervous system (Rohlman, 2006).
- During adolescence there are significant anatomical and maturational changes in the brain and so it is particularly vulnerable at this time (Rohlman, 2006).

Project Objectives

- To better understand the link between pesticide exposure in South Georgia migrant farmworker children and cognitive development.
- To better understand the knowledge of migrant farmworkers regarding the health-related effects of pesticides
- Provide vital information to health care professionals regarding pesticide exposure in this vulnerable population.

Research Design: Study Population

- Research subjects will be 30 - 40 children between the ages of 5-9 years old who migrate annually with their parents to South Georgia crop farms in Health District 8-2.
- The project will be headed out of a migrant farm worker clinic located in Ellenton, Georgia, which sees the majority of patients in this four county region of rural southern Georgia and falls under the umbrella of the Georgia Department of Public Health.

Research Design: Methods

- Biomarker urine sample collection for exposure analysis
- Health Survey
- Cognitive Development Testing

Biomarker urine sample collection for exposure analysis:

- Parents of the children will be instructed on how to collect the urine specimens.
- Collections will be taken at two different times, one collection at night and one in the morning.
- Specimens will be collected from the parents by the researchers within 24 hours of sample taken.
- Specimens will be appropriately preserved and packaged and transported to the Center of Disease Control, Atlanta, GA.
  - Laboratories in Atlanta will test the samples for levels of organophosphate pesticide metabolites in order to determine pesticide level exposures.

Health Survey

- The overall objective of the health survey is to gather more background information about the family, and the child participating, in order to control for confounding in the data analysis.
- A certified Spanish translator will translate the survey into Spanish. The survey will be given to parents at the beginning of the meeting, and can be read aloud if necessary by the PI.

Health Survey Questionnaire

- Has your child had any re-occurring health concerns in the past year?
- What is the age of your child?
- What was the maternal age at pregnancy?
- Has your child attended any formal schooling?
- What is the highest level of education of both parents?
- Are there older or younger siblings in the home?
- If so, how many, and what ages?

Cognitive Development Testing

- Sections of the Behavioral Assessment and Research System (BARS) test will be used for the cognitive assessment portion of the study.
- The BARS test measures several cognitive domains: cognitive, adaptive, motor, communication, and personal-social development (Berls et.al. 1999).

Cognitive Development Testing

- Examples of tests that measure these areas of cognition included in the chosen test batteries include:
  - Processing time of a response to stimulus
  - Ability to mentally focus
  - Rudimentary motor skills
- Examples of BARS tests to be used:
  - Playing a memory match game to test memory
  - Telling a story to assess memory
  - Having a child dribble a ball to assess hand eye coordination.

Statistical Considerations:

- Data will be analyzed using the appropriate statistical tests depending on the distribution of the scores and type of data. Information from the survey will be used to control for confounding. Statistical significance will be set a $p< 0.05$. All analysis will be done on a computer using commercial statistical software such as SAS, or EpiInfo.

Study Committee

- Dr. Chensheng Lu, Thesis Faculty Advisor, Emory University Rollins School of Public Health, Environmental and Occupational Health Department
- Dr. Judith Wold, Field Thesis Advisor, Director, Farmworker Family Health Program

Thank You

- Southeast Pediatric Environmental Health Specialty Unit
- Ellenton Clinic
- Farmworker Family Health Program
- Georgia Health District 8-2
- Faculty Committee, Emory University, Rollins School of Public Health and Nell HodgsonWoodruff School of Nursing

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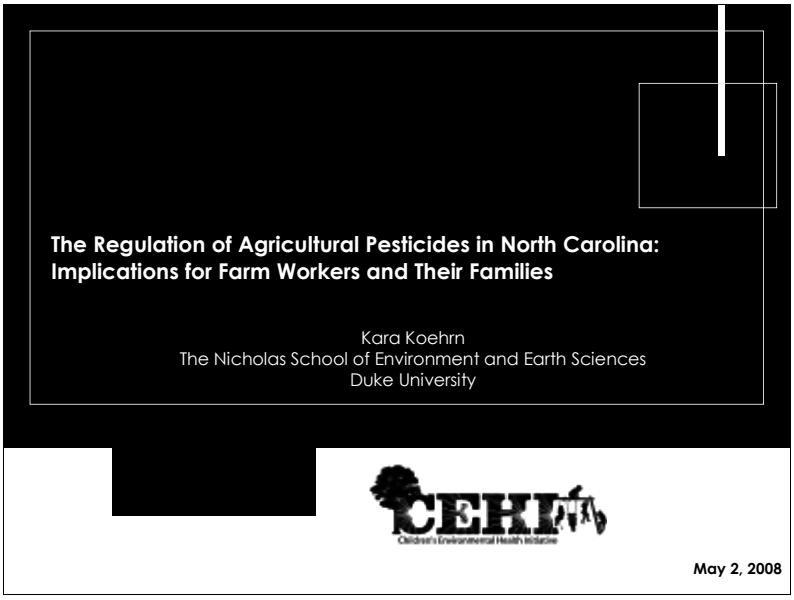
4. The Regulation of Agricultural Pesticides in North Carolina: Implications for Farm Workers and Their Families

Kara Koerhn, BS

Mentor: Martha Keating, MS
Children's Environmental Health Initiative, Duke University

In North Carolina, pesticide exposure is one of the most pressing issues facing an ever-growing population of migrant farmworkers. Of particular concern are potential adverse health effects for migrant farm workers' children due to their disproportionate exposure. This paper reviews possible exposure pathways and health effects of pesticides with an emphasis on these children. It also discusses the current protections that farmworkers receive under state law as well as the gaps in the law that leave this population and their families vulnerable. Finally, the paper concludes with areas that need improvement in order to create a more comprehensive system for protecting migrant farmworkers and their families from pesticide exposure.



The Issue

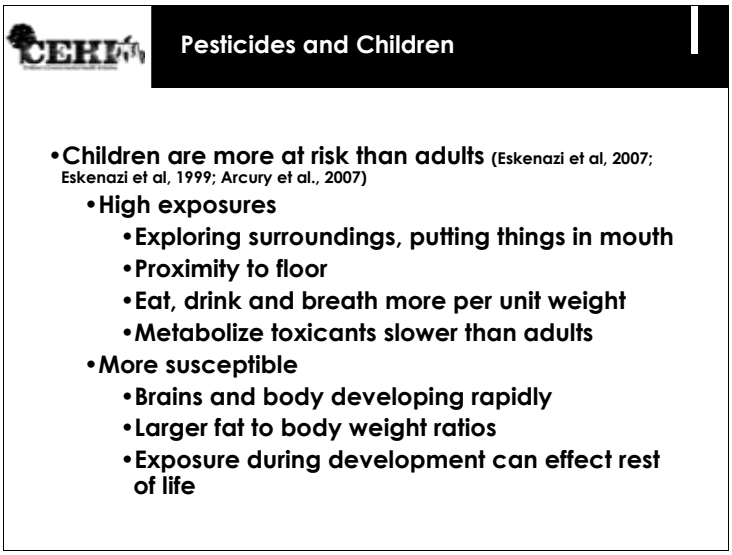
- Children of migrant farm workers who are at a social and economic disadvantage may be disproportionately exposed to pesticides.
- NC Hispanic community forum revealed pesticides as a main concern.

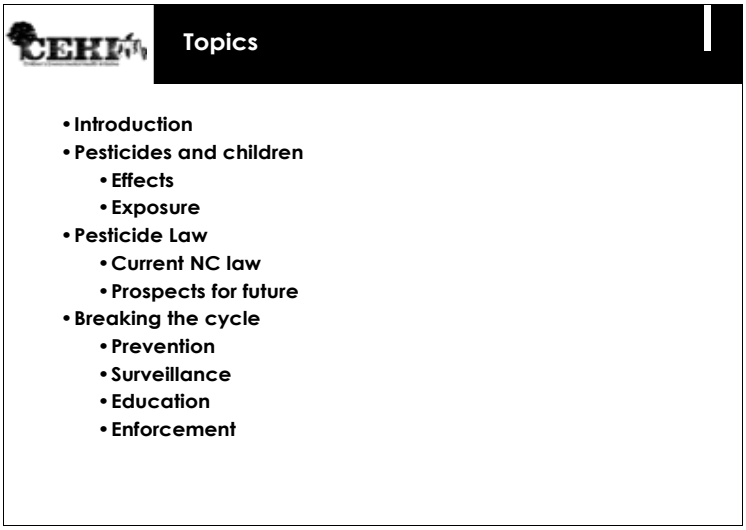
Topics for Today

- Introduction
- Pesticides and children
  - Effects
  - Exposure
- Pesticide Law
  - Current NC law
  - Prospects for future
- Breaking the cycle
  - Prevention
  - Surveillance
  - Education
  - Enforcement

Introduction

- Children of farm workers at risk
  - Agricultural communities have higher levels of environmental pesticides (Arcury et al., 2007)
  - Farm workers' homes (Quandt et al., 2004; Lu et al., 2000)
  - Exposure to multiple pesticides (Quandt et al., 2004; Arcury et al., 2007)
  - Health effects
    - Increased risk of leukemia and lymphoma (Birnbaum and Fenton, 2003)


Pesticides and Children
•Children are more at risk than adults (Eskenazi et al, 2007; Eskenazi et al, 1999; Arcury et al., 2007)
•High exposures
•Exploring surroundings, putting things in mouth
•Proximity to floor
•Eat, drink and breath more per unit weight
•Metabolize toxicants slower than adults
•More susceptible
•Brains and body developing rapidly
•Larger fat to body weight ratios
•Exposure during development can effect rest of life


Topics
• Introduction
• Pesticides and children
• Effects
• Exposure
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• Current NC law
• Prospects for future
• Breaking the cycle
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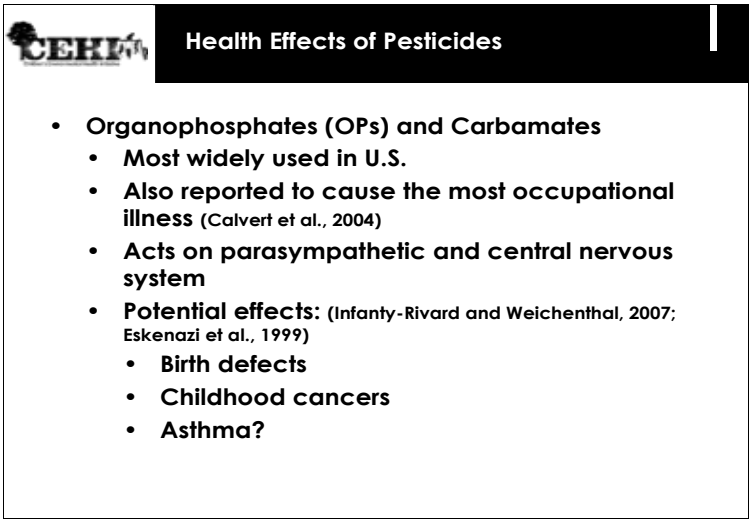
• Education
• Enforcement


Health Effects of Pesticides
• Organophosphates (OPs) and Carbamates
• Most widely used in U.S.
• Also reported to cause the most occupational illness (Calvert et al., 2004)
• Acts on parasympathetic and central nervous system
• Potential effects: (Infanty-Rivard and Weichenthal, 2007; Eskenazi et al., 1999)
• Birth defects
• Childhood cancers
• Asthma?

Health Effects of Pesticides

- Pyrethroids
  - Second highest illness incidence rate (Calvert et al., 2004)
  - Affects central and peripheral nervous system
- Herbicides
  - Variety of mechanisms
  - Concerns include
    - Mutagen, teratogen, carcinogen and endocrine disruptor

Topics

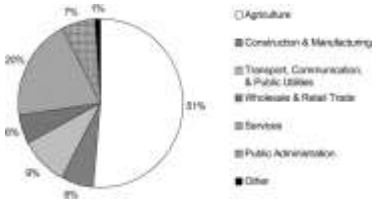
- Introduction
- Pesticides and children
  - Effects
  - Exposure
- Pesticide Law
  - Current NC law
  - Prospects for future
- Breaking the cycle
  - Prevention
  - Surveillance
  - Education
  - Enforcement

Exposure

- Exposure pathways
  - In the field
  - In the home
  - In utero

Exposure in the Field

- Country-wide study on children working as farm workers (Calvert et al., 2003)
  - Median age 16, ranging from 6-17
  - Acute occupational exposures happening mainly in agricultural occupations
  - Southern region had second highest incidence rate
    - Better reporting?



Calvert et al., 2004

Exposure in the Field

- Children were 1.7 times more likely to experience acute pesticide-related injury
  - Current regulations not sufficient
  - Less experienced
  - Less assertive
  - Training issues (part-time and seasonal work)
- Also noted that children underrepresented
  - Less likely to report injury

TABLE 3—Numbers of Cases of Acute Occupational Pesticide-Related Illness, Estimates of Hours Worked, Incidence Rates, and Incidence Rate Ratios, by US Region, 1993–1998

	Working Youths Aged 15–17 Years			Working Adults Aged 25–44 Years			
US Region	No. With Acute Occupational Pesticide-Related Illnesses	Estimated Total No. of Hours Worked*	Incidence Rate†	No. With Acute Occupational Pesticide-Related Illnesses	Estimated Total No. of Hours Worked*	Incidence Rate†	Incidence Rate Ratio (95% Confidence Interval)‡
Midwest§	89	5 220	17.0	1167	184 782	6.3	2.63 (2.26, 3.51)
Northeast§	26	2 569	10.1	938	150 948	6.3	1.71 (0.93, 3.16)
South§	126	5 370	23.2	2743	284 187	9.7	2.38 (2.08, 2.86)
West§	80	3 149	25.3	4688	275 767	16.7	1.85 (1.66, 1.86)
Total¶	313	16 328	20.4	9589	804 785	11.9	1.71 (1.53, 1.91)

(Calvert et al., 2003)

Exposure in the Field

- When are they being exposed?
  - 67% doing routine activities
  - 25% pesticide application process
- Consistent with similar study by CDHS (Das et al., 2001)
  - 64.4% doing routine activities
  - 28.6% pesticide application process
  - Study also reported
    - 41.3% dermal
    - 24.4% inhalation
    - 11.3% ocular

Exposure in the Home

- Sources of pesticides in the home (Arcury et al., 2007)
  - Pesticides tracked home ("paraoccupational exposure")
  - Drift from nearby fields
  - Residential pesticide use
- Long-term low-level exposure (Hoppin et al., 2006)
- Pesticides degrade more slowly (Hoppin et al., 2006)
- May be more detrimental than occupational exposures (Hoppin et al., 2006)

Exposure in utero

- Pesticides found in amniotic fluid (Eskenazi et al., 2007)
- Can pass through blood-brain barrier and placenta (Eskenazi et al., 2007)
- NC Ag-Mart case (Pattison, 2006)
  - Three mothers exposed
    - Tetramelia
    - Pierre Robin syndrome
    - Multiple deformities, eventually fatal
- Fathers' exposure (Chia and Shi, 2002)


(Collins, 2006)


(Collins, 2006)

Topics

- Introduction
- Pesticides and children
  - Effects
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- Pesticide Law
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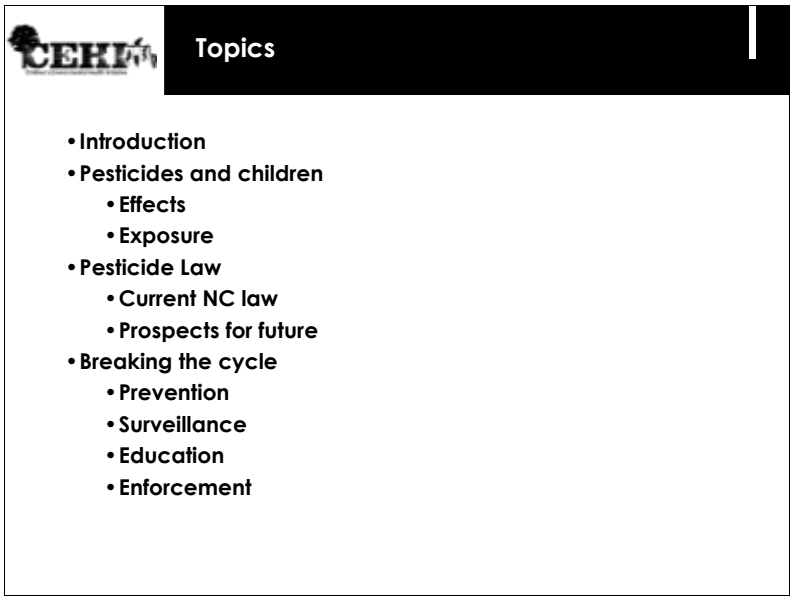
  - Prospects for future
- Breaking the cycle
  - Prevention
  - Surveillance
  - Education
  - Enforcement

North Carolina Pesticide Law of 1971

- Federal Law: Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)
  - Leaves a lot of authority to states
- Three state agencies
  - NC Department of Agriculture and Consumer Services (NCDA and CS)
  - NC Department of Labor (NCDL)
  - NC Cooperative Extension Service (NCCES)
- NC Pesticide Board
- Pesticide Advisory Committee

Problems with the Law

- Focus on crops
  - Ag-Mart example: using loopholes
- Surveillance
  - No link between violations and injury or death (Buhler et al., 2007)
  - Field sanitation violations are underrepresented, housing easier to catch (Buhler et al., 2007)
- Enforcement



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5. Awareness of Environmental Justice Issues through a Case Study of Anniston, Alabama

Brittany Benson, Dominique Bibbins, Deanna McGarity, & Amirah Patterson

Mentor: Joanne Chu, PhD
Department of Biology, Spelman College

Environmental health disparities (EHD) are disease issues that disproportionately affect particular populations due to complex interactions with environmental conditions. Perpetuation of EHD can be viewed as a closed "cycle" in which factors such as poor living conditions and limited health care exacerbate disease states. The purpose of this study was to investigate whether using an undergraduate curriculum that promotes awareness of EHD among students to develop a potential for leadership and empower them to consider a career and community involvement that could help reduce EHD and develop creative ways to "*Break the Cycle*". In Fall 2007, sophomore and senior students in the biology department at Spelman College examined a case study of Polychlorinated Biphenyl (PCB) contamination on an African-American community in Anniston, Alabama, a landmark case of EHD. Students were interviewed following the conclusion of the course regarding their attitudes and awareness of EHD. .We predicted three qualitative outcomes from our study: 1) students would show increased interest in health disparity careers, 2) students would show increased interest in non-medical environmental health disparities careers, 3) students would show increased awareness/interest in community involvement with environmental health disparities issues. Data from our interviews supported some of our predictions. Implications for future use of undergraduate curriculum to promote interest in the cycle of environmental health disparities are discussed.

Use of Undergraduate Curriculum as a Vehicle for Breaking the Cycle of Environmental Health Disparities within Disadvantaged Communities

Brittany Benson, Dominique Bibbins, DeAnna McGarity, Amirah Patterson, Joanne Chu, PhD

Department of Biology, Spelman College

Spelman College – A New Curriculum for Biology Majors (Fall 2006)

New Courses and Course Objectives

Bio 285/485 - *Sophomore/Senior Seminar* Course Objectives:

- Encourage application of Biological perspectives broadly to the "Real World"'
- Encourage critical thinking/writing/reflection
- Encourage broad consideration of professional careers (beyond MD)
- Committee building among faculty, teaching staff, seniors and sophomores

Bio 285/485 – Sophomore/Senior Seminar (Fall 2007)

150 Students examined the Anniston, Alabama PCB contamination case study from varying perspectives:

- Popular Press reports (e.g. Anniston Star, New York Times, Environmental Justice websites)
- Invited guests directly/indirectly involved with the Anniston case from various disciplines
- Student led discussion
- Student composed reflection papers

A case for Environmental Injustice: Anniston, PCBs and Monsanto

- Anniston is a small town in Alabama that was severely contaminated with Polychlorinated Biphenyls (PCB's) for over thirty years.
- Monsanto (now Solutia) is responsible for the continuous dumping of PCB's within the town's rivers and ground water supply for over 40 years.
- This PCB contamination is said to have caused rare forms of cancer, behavioral and learning disabilities, birth defects, and other serious health problems within the town's population.
- Population affected – mostly lower socioeconomic, predominantly African American

Background – Anniston, AL

- Severely contaminated with Polychlorinated Biphenyls (PCBs) for >30 years
- Monsanto responsible for dumping PCBs in town's:
  - rivers
  - ground water supply
- Possible Results
  - forms of cancer
  - behavioral and learning disabilities
  - birth defects
  - and other health problems

Invited Guests

Jewell Harper, J.D

Shirley Baker, LPN

Invited Guests

Leslie Rubin, MD **Stephanie Miles Richardson, DVM, PhD**

Course Structure

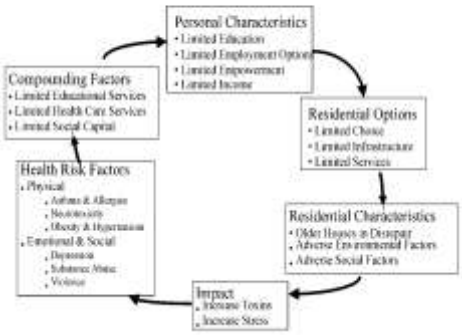
- Entire class read and discussed case study materials in breakout groups (~ 15/group)
- Team of 3 seniors would introduce guest – educational and professional trajectory, bio sketch, involvement with Anniston's case
- Class would generate questions to ask guest the following week
- Guest was invited to speak *briefly* (10 min.)
- Guest was asked questions generated by students in a town hall format
- All sessions were videotaped

Main Study Questions:

1. Did this course affect students perspective on Environmental Justice issues?

2. Can courses such as this affect change in "breaking" the environmental health disparities cycle?

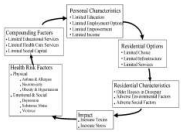
The Cycle of Environmental Health Disparities ( )



More Specific Questions:

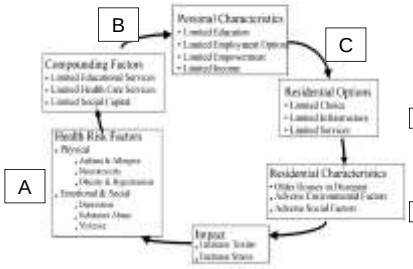
- What was student knowledge about EHD prior to the course?
- Would students apply new knowledge to increased interest in EHD medical career options?
- Would students apply new knowledge in EHD non-medical career options?
- Would students change personal behaviors with regard to EHD?
- Can students apply knowledge to institutional changes with regard to EHD (Spelman College, Church, other community organizations)?

Methods



- Develop a questionnaire that evaluates the previous questions
- These questions will be asked in student peer group interviews (sophomores and seniors grouped separately)
- Extract general trends and apply to the EHD Model
- Some sample interview questions:
  - Prior to taking Bio 285/485, what did you know about the concept of environmental health disparities?
  - Were you aware of the relationships between race, class, and exposure to environmental toxins?
  - Do you think this class has impacted the cycle, and if so, where?
  - Have your thoughts about career choices been impacted by what you learned in this course?
  - What ways can an institution like Spelman impact the cycle?
  - What ways can the community help “break the cycle”?

Predicted Results



Undergraduate curriculum as a vehicle to *Break the Cycle* of Environmental Health Disparities within disadvantaged communities. We predict the following impact:

A We can show increased interest in the medical careers that focuses on health disparities such as cancer, diabetes, hypertension, etc.

B We can show awareness and interest in careers in the non-medical fields – such as law, public policy, and environmental justice.

C We can impact our community values through engaging with church, community and families activities.

Conclusions

- Undergraduate curriculum is a novel approach for increasing awareness in EHD issues – especially in the liberal arts.
- Biology majors can be engaged to consider EHD issues within their own career choices
- Biology majors are open to considering non-medical careers – if the context of biology applied to the "real world" is presented.
- Students are open to apply knowledge of EHD to their own worldview and behaviors

Future Directions

- Professionals in EHD fields should engage college faculty (and administrators!) in conversation about the impact curriculum have on student engagement with health disparity issues
- Professionals in EHD fields could think creativity about engaging other science and non-science disciplines in such novel collaborations (e.g. chemistry, mathematics, political science, women's studies, history, sociology)

Acknowledgements

Leslie Rubin, MD

Southeast Pediatric Environmental Health Specialty Unit

Cynthia Bauerle, PhD

Howard Hughes Medical Institute

Center for Behavioral Neuroscience

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6. Breaking the Cycle: Low-Income & Minority Children with Asthma

Brian Basinger, JD

Mentor: Charity Scott, JD
College of Law, Georgia State University

The U.S. medical community continues to lead the nation in recognizing the pressing need for enhanced efforts in dealing with childhood asthma. However, the legal community has yet to embrace a comprehensive profession-wide response to asthma, the chronic lung disease which affects nearly one out of every ten children in the United States. This paper will explore the various methods by which lawyers and lawmakers can use their professional skills to improve the health of children suffering from asthma, covering a range of options from state and local laws to pro bono work. It is critical to ensure the legal community realizes that it holds many of the keys to halting the effects of childhood asthma because, as one state asthma expert explained, there are policymakers who "are still with the mindset that asthma is a mind over matter kind of thing." With overall infant death rates now climbing in several Southern states after years of decline, and the disparate ratio of black-to-white child asthma deaths increasing dramatically from year to year, the time for the legal community to act is now – particularly in the South.

Part I of this paper will examine the nature and extent of asthma among U.S. children, noting in particular how children from low-income and minority backgrounds are especially likely to face health complications from asthma. This section will touch on the triggers which lead to asthma attacks, such as second-hand smoke and mold. Emphasis will be placed on the drastic physical and educational costs suffered by children who experience asthma attacks, while also noting the fiscal ramifications to hospitals and schools. As one lawmaker explained, "If you can't breathe, you can't concentrate on what's going on in the classroom."

Part II of this paper analyzes the ways in which the health of asthmatic children suffers due to certain social and economic determinants, such as lack of access to health-care and poorly ventilated homes. Specific focus will be placed on new guidelines by the National Institutes of Health calling for increased efforts to control day-to-day asthma symptoms and not just severe attacks. This section also addresses how various health policies and laws contribute to the overall problem of asthma by examining the lack of comprehensive efforts by state lawmakers, education officials, and other leaders to seek improvements in asthma management, treatment, and prevention. This section will underscore why certain factors contributing to asthma symptoms, such as bus emissions and second-hand smoke, are best mitigated and addressed by members of the legal community using their policymaking powers.

Part III will follow by proposing various kinds of legal options for treating and preventing asthma in low-income and minority children, ranging from pro bono efforts of individual attorneys who can compel landlords to clean mold from apartments to statewide policies on asthma management and trigger control. This section will highlight actions that can be taken by school boards, state legislatures, community advocates, parents, and students to reduce children's exposure to asthma triggers during their daily lives at home, at school, and in public.

Breaking the Cycle:
Low-Income & Minority Children with Asthma

- by Brian Basinger
- Third-Year Law Student
- Georgia State University College of Law
- Graduate Research Assistant
- Center for Law, Health, & Society

Kellen Edwin Bolden

- Diagnosed with asthma at 4-months-old.
- Loved sports.
- Severe attack on way to school bus.
- Local school policy in 2001 banned inhalers.
- Dead at 10.

What could have been different that day?

Potential Legal Solutions to Asthma – Many Forms!

- Practical Solutions/Policy Shifts
- Statewide and Local Laws
- Budgets/Research Funding
- Administrative Laws
- Pro Bono Work
- Community Activism

The Legal Community has a role to play in improving the health outcomes of asthmatic children.

- Changes in science.
- Disproportionate impact on identified populations.
- Tools of change easily accessible.

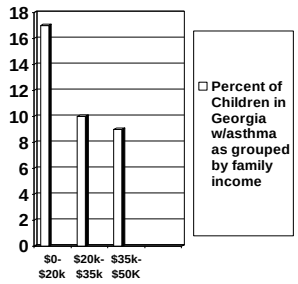
Changes in Science: Shift in Focus on Asthma:

- NIH guidelines of 2007 show shift in asthma management.
- Must manage *day-to-day* exposure.
- Flare-ups, severe attacks not the first sign of trouble.
- **Asthma not controlled if you wake up at night gasping for air, or avoid exercise altogether.**

Disproportionate Impact seen among Identified Populations

- Highest rates of asthma among those children whose families ***earn the least***.

Ga. Dept. of Human Resources

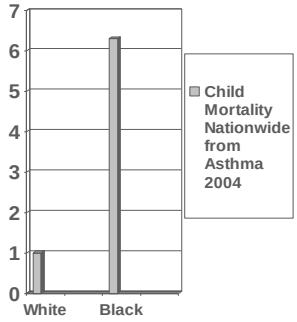


Why is it important to know this?

- These families are eligible for health-focused legal aid in many places.
- Government programs can be tailored/created to address specific communities.

Disproportionate Impact by Race: Mortality Ratio

- In 2004, for every one white child killed by asthma, 6.3 black children also died.
  - U.S. Dept. of Health and Human Services, The State of Childhood Asthma, United States, 1980-2005



What does this mean to the legal community?

- Legal solutions, such as education and intervention efforts, can be tailored and targeted for communities most in need.
- Scarce resources allocated efficiently.

It's time for the Legal Community to act by using tools of change.

<u>Policy Solutions:</u> Changing the focus.

- Day-to-day management of symptoms.
- Not just emergency treatment.
- Applies to nationwide laws to local school board rules.

Policy Shift Needed for Lawmakers and Leaders:

- Some policymakers "are still with the mindset that asthma is a mind over matter kind of thing."

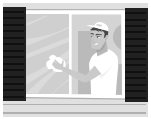
  Carolyn Williams, Georgia Dept. of Human Resources Asthma Program Manager. [Interview, Aug. 28, 2007].

Legislative Solutions

- Asthma Management plans
- Bus idling laws
- School Locations
- Inhaler access
- Nurse funding
- Ban smoking in cars w/kids
- Chemical bans

Administrative Solutions

- State Dept. of Education
- School Boards
- State Dept. of Environmental Protection
- EPA's Clean School Bus Program (retrofitting grant)



Pro Bono Work/Legal Aid

- Firm policy on pro bono.
- Health Law Partnership
  - Targets children at/below 200% FPL.

Community Activism

- Lobby for change
- Testify before decision-makers
- Organize local efforts

Budgeting/Research

- Federal and State Budgets
- Projects have shown success in reducing asthma trigger exposure.
- Research funding

Good News!

- Extra Money in 2008
- Master Settlement Agreement
- Additional $1 billion infusion to states.

What legal interventions could have made a difference?

Inhaler
Asthma action plan
Chemicals
School location
Bus idling
Nurse training
Teacher training
Smoking Bans

Legal changes can improve health outcomes for asthmatics

- Legal community must recognize its role.
- Work with medical and education professionals to develop comprehensive approach.
- Tools are here.
- We only need the will to act.

ACKNOWLEDGEMENTS:

The author would like to acknowledge Professor Charity Scott, Director of the Center for Law, Health, & Society at the Georgia State University College of Law in Atlanta. Without her guidance and passion for health-care equality and justice, none of this work would be possible.

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Interview with Kenneth Ray, Georgia Dep't of Human Resources, Tobacco Use Prevention Manager (September 4, 2007) [hereinafter "Ray Interview"] (permission given as a source for this publication).

Break the Cycle Faculty

National Center for Chronic Disease Prevention and Health Promotion
Centers for Disease Control and Prevention

Keynote Speaker

Camara Phyllis Jones, MD, MPH, PhD

Camara Phyllis Jones, MD, MPH, PhD is Research Director on Social Determinants of Health and Equity in the Division of Adult and Community Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention.

Dr. Jones is a family physician and epidemiologist whose work focuses on the impacts of racism on the health and well-being of the nation. As a methodologist, she has developed new methods for comparing full distributions of data (rather than means or proportions) in order to investigate population-level risk factors and propose population-level interventions. As a social epidemiologist, her work on "race"-associated differences in health outcomes goes beyond documenting those differences to vigorously investigating the structural causes of the differences. As a teacher, her allegories on "race" and racism illuminate topics that are otherwise difficult for many Americans to understand or discuss. She hopes through her work to initiate a national conversation on racism that will eventually lead to a National Campaign Against Racism.

Dr. Jones was Assistant Professor at the Harvard School of Public Health in the Department of Health and Social Behavior, the Department of Epidemiology, and the Division of Public Health Practice from 1994 – 2000. She is currently Adjunct Associate Professor at both the Morehouse School of Medicine and the Rollins School of Public Health (Emory University). From January through September, 1999 she was also an Ian Axford Fellow in Public Policy, working in the Maori Health Branch of the New Zealand Ministry of Health in Wellington, New Zealand on the question, "Maori-Pakeha Health Disparities: Can Treaty Settlements Reverse the Impacts of Racism?"

Dr. Jones is an inaugural member of the National Board of Public Health Examiners, and recently completed service on the Executive Board of the American Public Health Association, the Board of Directors of the American College of Epidemiology, and the Board of Directors of the National Black Women's Health Project. She was honored as the first recipient of the David Satcher Award by the Association of State and Territorial Directors of Health Promotion and Public Health Education in May 2003.

Institute on the Study of Disadvantage and Disability

Break the Cycle Co-Director and Editor-in-Chief

Leslie Rubin, MD

Leslie Rubin MD, President and Founder of the Institute for the Study of Disadvantage and Disability, is visiting Schol Department of Pediatrics at Morehouse School of Medicine in Atlanta, Georgia, Medical Director of Team Center Chattanooga, Tennessee; Medical Director of Adult Down Syndrome Program and Co-director of the Southeast Environmental Health Unit at Emory University, Department of Pediatrics, Atlanta, Georgia.

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 he moved to 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. Since 1998 he has been involved with the Southeast Pediatric Environmental Health Specialty Unit at Emory University, 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 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 on a number of local, regional, national and international committees and projects that address the needs of children and adults with Developmental Disabilities.

Relevant & Recent Publications:

I Leslie Rubin, Allen C. Crocker: *Delivery of Medical Care for Children and Adults with Developmental Disabilities. 2nd Edition.* Paul Brookes, 2006

Howard Frumkin, Robert Geller, I Leslie Rubin with Janice Nodvin: *Safe and Healthy School Environments*. Oxford University Press, 2006

Environmental Protection Agency, Region IV

Faculty

Beverly Banister

Beverly Houston Banister is Director of the Air, Pesticides and Toxics Management Division at the Environmental Protection Agency (EPA) Region 4 office in Atlanta, Georgia. She is responsible for planning, coordinating, and implementing all Regional EPA Air, Pesticides, and Toxics programs. Ms. Banister has also provided management and leadership to both the Waste and Water Management Divisions. She has been with EPA for more than 22 years and has extensive experience in many EPA programs and offices including EPA Headquarters. Ms. Banister has been recognized with many awards for her knowledge, skills, and leadership abilities which produced environmental results. She was the recipient of the Federal Executive Board EPA All Star Award, the Donald J. Guinyard Pioneer Achievement Award and the prestigious Lee M. Thomas Excellence in Management Award. In addition, to these career achievements and honors, Ms. Banister has provided leadership to numerous organizations within and outside EPA. Ms. Banister has a special interest in providing opportunities for disadvantaged children. She is a graduate of Auburn University with a degree in Chemical Engineering.

Emory University, Department of Pediatrics

Faculty

Robert J. Geller, MD

Robert J. Geller, MD assumed the role of PEHSU Director in August 2005. 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 19 years. He currently is a member of the Board of 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.

Emory University, Rollins School of Public Health

Faculty

Michele Marcus, PhD

Michele Marcus, PhD is Professor of Epidemiology and Environmental and Occupational Health at Emory University's Rollins School of Public Health. She has over 20 years experience as a reproductive and environmental epidemiologist. At Mount Sinai School of Medicine, she was Director of the Environmental Epidemiology Core of the NIEHS Environmental Health Sciences Center. As a Turner Foundation Fellow at the CDC she coordinated the work of the Endocrine Disrupters Leadership Panel. She has published extensively in this field and has co-authored two book chapters reviewing the effects of environmental and occupational exposures on reproductive function. Her work includes studies of prematurity, low birth weight, congenital malformations, child growth and pubertal development, adolescent pregnancy,

miscarriages, menstrual function, infertility and menopause. She has served on federal expert panels reviewing the health effects of exposure to electromagnetic fields, bisphenol A, phthalates, gene/environment interactions and service in the Persian Gulf War as well as an ATSDR/CDC panel which recommended biological markers of adverse reproductive outcome to be used in communities exposed to putative reproductive toxins. She was recently named to the National Academy of Sciences Institute of Medicine Committee to update the evaluation of health effects of dioxin exposure among Vietnam Veterans. Dr. Marcus has also conducted research on genetic contributions to reproductive health and health effects of exposures to polycyclic aromatic hydrocarbons, pesticides, air pollution, solvents and lead.

Faculty
Mildred Maisonet, PhD

Mildred Maisonet, PhD initiated her career as an environmental epidemiologist with the Agency for Toxic Subtances and Disease Registry in Atlanta, GA, where she received an Employee of the Year award for her work on a study on risk factors for elevated blood lead levels in children. Mildred obtained a PhD in epidemiology from the Johns Hopkins University Bloomberg School of Public Health. After finishing her PhD she took a job with the Pan American Health Organization, Regional Office of the Americas for the World Health Organization, as Regional Advisor for Sustainable Development and Environmental Health. Her role was to develop programs oriented towards building the capacities of Latin American and Caribbean countries in the identification and study of the effects of environmental risk factors on human health. She is currently in Atlanta, Georgia where she is collaborating with the CDC in the conduct of research on the effects of endocrine disrupting chemicals on pubertal development. She was recently appointed Adjunct Assistant Professor of epidemiology at Emory University's Rollins School of Public Health and is planning to conduct research on risk factors for pubertal development in minority populations.

Student
Amparo Gonzalez-Feliciano, BS

Amparo Gonzalez-Feliciano received her BS, Magna Cum Laude in a Industrial Biotechnology at the University of Puerto Rico at Mayagüez, Class 2005. Her interest is to apply the knowledge gained through her undergraduate studies to population level research with special interest in minority populations. She has been a Research Assistant at the Rollins School of Public Health under Dr. Bostick and currently under Dr. Marcus and has interned at Thousand Oaks, California and Iowa State University. Ms. Gonzalez-Feliciano will receiver her Master of Public Health in Epidemiology with the Rollins School of Public Health Class of 2009 and plans to collaborate in studies of determinants of early pubertal development in girls.

Duke University, Children's Environmental Health Initiative

Faculty
Pamela Maxson, PhD

Pamela Maxson, PhD 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.

Student
Kelly Henderson

Kelly Henderson is a junior at Duke University studying psychology and environmental science. Kelly is apart of the Human Development Certificate Program where she is pursuing her interest in the interaction of development and environmental science. Kelly just returned from studying abroad in Buenos Aires, Argentina and she is member of the Duke Women's Club Soccer Team. She will graduate in May of 2009.

Emory University, Rollins School of Public Health

Faculty

Chensheng (Alex) Lu, PhD

Dr. Alex Lu is an Assistant Professor in the Department of Environmental and Occupational Health, Rollins School of Public Health at Emory University. Dr. Lu's primary research interest is in the area of environmental exposure biology focusing on pesticide exposure and health risk assessment. Dr. Lu is developing a research program integrating novel exposure assessment tools, physiologically-base pharmacokinetic models and cumulative risk assessment models. Dr. Lu currently serves as a Member on the Scientific Advisory Panel for the US EPA Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and a Member of the Scientific Review Board for the US EPA Federal Food Quality Protection Act (FQPA). Dr. Lu is also currently served as an ad hoc member on the National Institute for Occupational Health and Safety (NIOSH) grant peer-review panel. Part of the data that Rachel Kauffman and Dr. Lu will be presenting today will also be presented in the 10th International Symposium on Neurobehavioral Methods and Effects in Environmental and Occupational Health in San Jose, Costa Rica in June 2008.

Student

Rachel Kauffman, BSN

Rachel Kauffman, a practicing registered nurse, received her nursing degree in 2007 from the Medical College of Georgia and has studied at Indiana University at Indianapolis and Goshen College. Her interest in environmental health and vulnerable populations has led her to a way of connecting the two interests. She is currently working on a dual degree from Emory University – a MSN in Public Health Nursing and a MPH in Global Environmental Health. Ms. Kauffman is interested in continuing studies in environmental health issues and working towards decreasing health disparities in a global context. She wishes to take this knowledge and use it to further educate health professionals at all levels (nurses, physicians, public health professionals), to enhance training in environmental health and providing data for evidenced-based practices. In addition, with such research and training, she would also like to see these efforts put into practice, by integrating them into the legal community (educating lawmakers) in order to provide greater legal protection for health impacted by environmental issues.

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.

Student

Kara Koehrn, BS

Kara Koehrn graduated Cum Laude from Davidson College with a BS in Biology. where she worked as a field biologist for the San Diego Zoo for five summers, collecting data on two species of endangered birds in southern California: the California Least Tern and the Western Snowy Plover, and for one summer at the Salk Institute in San Diego in a lab working on a project investigating the relationship between loss of germline stem cells and life span in Drosophila. Ms. Koehrn is currently working on a masters of environmental management in Richard DiGiulio's lab at Duke where she is

aiding in the research involving polycyclic aromatic hydrocarbons (PAHs) exposure in Atlantic killifish. In her graduate work she is mainly interested in how toxins move through the environment and how they affect human health. Ms. Koehrn is particularly interested in social justice issues that arise from toxic exposures. This project on migrant worker's children exposure to pesticides is a good combination of environmental factors effecting human health. It also incorporates some policy, and raises an issue that highlights a need for change to reduce such exposures. During the summer she will work as a Stanback Fellow for Blue Ridge Environmental Defense League in an ongoing project investigating the relationship between asphalt plant emissions and cancer and depression rates in Salisbury and other communities in NC.

Spelman College, Department of Biology

Faculty

Joanne Chu, PhD

Joanne Chu, PhD is Assistant Professor in the Department of Biology at Spelman College. Her research investigates the interactions of various neurochemical systems in the neural control of social/reproductive behavior. Her laboratory uses reproductive behavior in anuran amphibians (frogs and toads) as her model system. Hormonal control of reproductive behavior involves complicated interactions among sex steroids, classic neurotransmitter systems and other neruohormones. Her research examines the effects of dopamine and the neuropeptide vasotocin in the regulation of social and motor behaviors in the green-tree frog (*Hyla cinerea*). Studies in her laboratory examine fundamental neural circuitry that regulates social behavior in all vertebrates. Her laboratory utilizes behavioral, pharmacological, neuroanatomical and molecular approaches to investigate these questions. Dr. Chu has been at Spelman College since 2002. She received her PhD in Behavioral Neuroscience from the University of Texas, Austin and was a postdoctoral fellow at Oregon State University. Dr. Chu conceived and initiated the course project with her biology students examining the effects of toxic exposure on the community of Anniston, Alabama. Dr. Chu is currently teaching at Agnes Scott College.

Student

Brittany Benson

Brittany Benson is a sophomore at Spelman College with interests in Public health and helping with common health disparities among the world. Ms. Benson plans on continuing her interest in conducting research in Public Health with a goal in finding new ways of prevention that will possibly have a great effect on our country and break many cycles in a number of health disparities.

Student

Dominique N. Bibbins

Dominique Bibbins is a sophomore at Spelman College and is interested in Public Health and Health Disparities. She plans to expand my knowledge in the field of Public Health.

Student

DeAnna McGarity

DeAnna McGarity aspires to be a pediatric oncologist with an interest in public health. She wants to work in underprivileged countries and parts of the United States to promote cancer awareness and prevention. Ms. McGarity participated in the Pediatric Oncology Education Program where she learned a lot about the disparities within cancer patients because of environment and available resources through our daily seminars. Her honors include ABCRMS Cell Biology Oral Presentation Award, 2007; Merck Scholar, 2008

Student

Amirah Patterson

While studying abroad in South Africa during the Fall of 2006, **Amirah Patterson** gained interest in environmental health disparities. *Cities of the South*, taught in the environmental and geographical sciences department, was a course that immensely impacted her life. This class primarily focused on problems in the Global South, formerly known as the Third World, including urban poverty, housing, access to water, sanitation, and prevalent health issues. In addition, by volunteering in local schools and mobile clinics, she became increasingly aware of the major environmental health disparities that exist. This interest was increased when the Seminar class at Spelman College's Biology Department was

focused on interpreting a local environmental health incident. Ms. Patterson is currently part of the Howard Hughes Research Fellowship Program and presented at Spelman College's Research Day. Ultimately, Ms. Patterson plans on becoming a physician and continuing research she would also like to attend public health school because it is important to know how to alert the afflicted populations of advances in medicine and research.

Georgia State University
College of Law

Faculty
Charity Scott, JD

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, and she 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; serves on the American Bar Association's Special Committee on Bioethics and the Law and Medical-Legal Partnership Working Group; and serves on the Board of Directors of the Public Health Law Association. She is Past Chair of the ABA Health Law Section's Interest Group on Medical Research, Biotechnology, and Clinical Ethics and Past Chair of the Health Law Section of the State Bar of Georgia. Professor Scott earned her JD from Harvard Law School in 1979 (cum laude), and her A.B. with honors from Stanford University in 1973 (Phi Beta Kappa).

Student
Brian Basinger, JD

Brian Basinger holds his undergraduate degrees from University of Georgia – one in ABJ in Public Relations (2001) and a BA in Romance Languages (2001). Mr. Basinger will receive his law degree in May 2008. Before law school, he served as a newspaper reporter covering the state government for the papers in Athens, Augusta, and Savannah. He had broad exposure to health-care laws and budgeting. As a result, helped the College of Law's Center for Law, Health & Society by investigating how the legal community can improve the health outcomes of low-income children. Asthma laws were one of the areas he studied. The others included domestic violence, and housing and the physical environment. Brian Basinger joined the law firm of King & Spalding in the fall of 2008.

Editorial Team

Leslie Rubin, MD *Editor in Chief*
Janice Nodvin *Project Coordinator*
Kelly J. Ace, PhD, JD *Content Editor*

CONCLUSIONS

Break the Cycle of Environmental Health Disparities in Vulnerable Children provided nine students 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 six 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. (Figure 4)

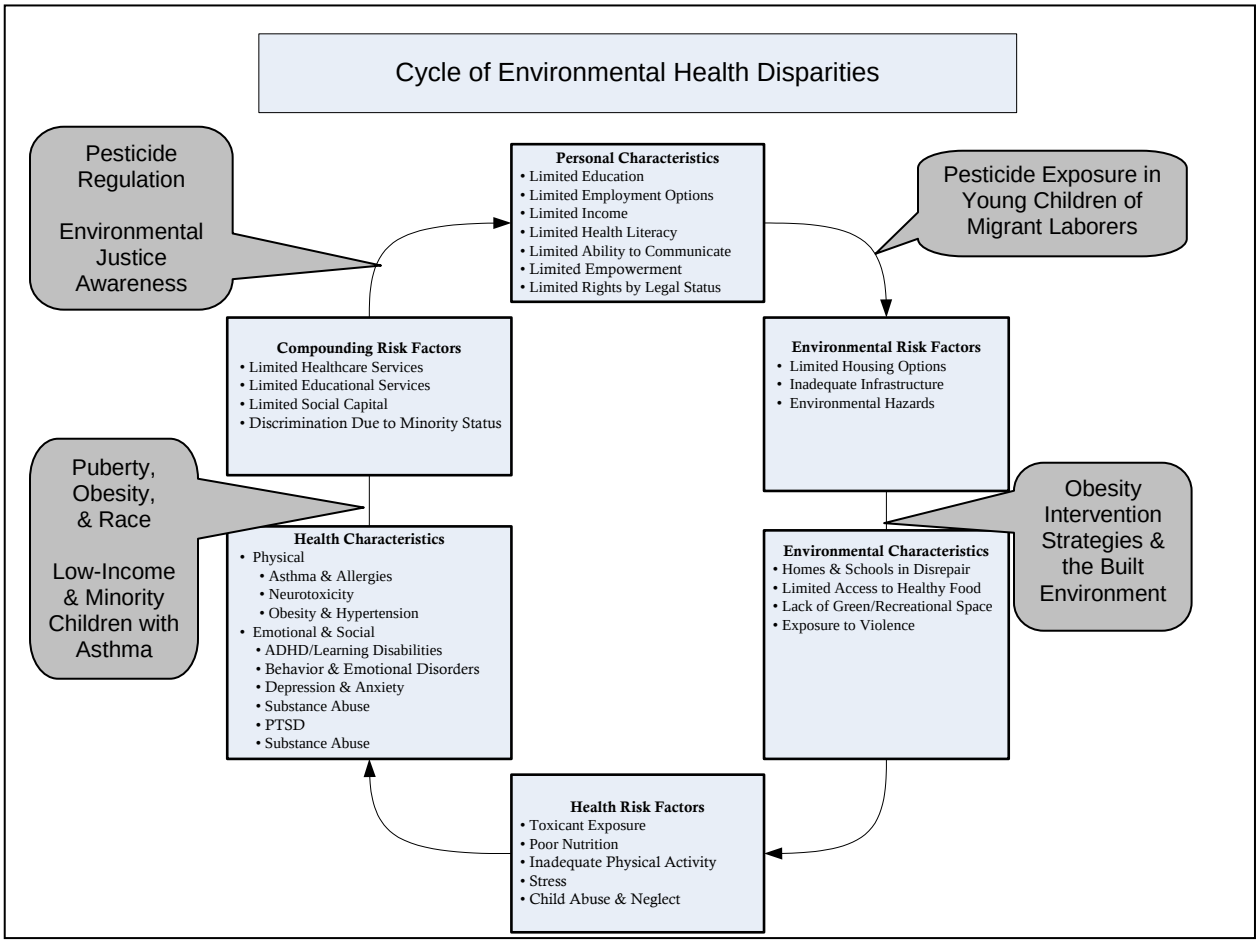

Figure 4: Projects Highlighting Opportunities for *Breaking the Cycle of Environmental Health Disparities*

Access to Healthy Foods & Safe Spaces that Encourage Physical Activity

Childhood obesity has reached nearly epidemic proportions. Children who are obese experience higher rates of asthma, hypertension, and diabetes. Because they often require ongoing medication to manage related health problems, they are also at higher risk for medication-related side-effects. Being overweight or obese can also lead to negative social experiences, such as teasing and bullying, which can, in turn, affect mental health, body image, and self-esteem. These physical and psychosocial effects can, in turn, have a negative impact on children's academic performance, social relationships, and general wellbeing.

Environmental factors that influence diet and exercise play a significant role in the development and perpetuation of childhood obesity. Children are more likely to eat high-calorie diets lacking essential nutrients if they live in impoverished neighborhoods where affordable fresh fruits, vegetables, and lean meats are not readily available. Those who are obese may be especially prone to eat as a way to cope with environmental and emotional stressors ("stress-eating") or to satisfy the increased appetite that tends to accompany weight gain. Children are less likely to engage in adequate levels of physical activity if they lack access to safe recreational areas and spend most of their free time engaging in sedentary activities such as watching TV. Children who are overweight or obese may be especially disinclined to exercise if their condition causes them physical discomfort, makes it more difficult for them to keep up with thinner peers, or increases feelings of embarrassment and self-consciousness about their appearance.

Studies such as the one conducted by Kelly Henderson of Duke University suggest that environmental factors can significantly contribute to the higher rates of childhood obesity among children who belong socially and economically disadvantaged minority groups. Ms. Henderson found that the low-income neighborhoods she studied in central Durham, NC were dominated by convenience stores and fast-food restaurants. She also found that most lacked safe, usable sidewalks and park space. Because of this, the children who lived in these communities were at increased risk for being overweight and obese.

This increased risk of obesity may have special health implications for girls. Amparo Gonzalez-Feliciano of Emory University found that the increasing rate of early menarche in Black girls is directly related to the increasing prevalence of obesity within that group. Early menarche has its own complications. It is associated with adverse changes in insulin, lipid levels, adiposity, and blood pressure, as well as increased asthma severity. It is also associated with earlier sexual activity, earlier alcohol use, and teen pregnancy.

Ms. Gonzalez-Feliciano's findings suggest that the interaction of specific environmental and genetic factors that lead to childhood obesity may also increase the risk of health complications related to early menarche, at least in some girls.

Both Ms. Henderson's and Ms. Gonzalez-Feliciano's findings suggest that increasing access for children to healthy foods and safe recreational spaces may represent a practical approach to addressing childhood obesity and minimizing its long-term effects. Their findings also underscore the importance of children regular comprehensive health evaluations to identify and address environmental health concerns that contribute to childhood obesity.

Promoting Informed Public Policy, Legal Access, & Individual Empowerment

Legislation and administrative regulations can go a long way toward shaping the environment in which children develop and grow. It can also help ensure access to resources that promote health.

Individuals who are at a disadvantage economically and socially lack the political and social capital necessary to directly influence public policy. They also tend to lack meaningful access to courts where they might seek enforcement of their rights or redress for torts that have affected their health. Children living in such circumstances are further disadvantaged by their minor status, so must depend on adults to advocate on their behalf.

The cycle of environmental health disparity is likely to continue unless legislators and public administrators institute laws and public policies designed to protect and support the health of those who are most vulnerable to environmental health concerns. Informed advocates can play an important role in educating and motivating such officials – especially when the children and families affected are not able to effectively advocate on their own behalf.

Georgia State University law student Brian Basinger initiated his project in response to a preventable tragedy that might easily have been repeated: a child dying because he was not permitted to self-administer his asthma medication at school. Mr. Basinger researched the relevant medical and legal issues; identified options for strengthening asthma prevention and treatment efforts through legislation, regulation, and litigation; and then shared his findings with the relevant policy-makers. His efforts resulted in the passage of a law mandating that schoolchildren be permitted to carry and self-administer life-saving medications in the event of an emergency.

Kara Koerhn of Duke University also examined how policy can either reinforce or break the cycle of environmental health disparities. Her project examined the regulations designed to protect farmworkers and their children, and, identified gaps in the law that leave this population and their families at high risk for adverse health outcomes from pesticide exposure. She also looked at how policy can be used to protect the children of farmworkers and their families from pesticide exposure.

Understanding Diverse Populations

While individuals and families living in circumstances of social and economic disadvantage share many characteristics, they are not one homogenous group. Breaking the cycle of environmental health disparity requires an understanding of how factors such as culture, religion, sexism, racism, and xenophobia both contribute to the cycle and suggest opportunities for interrupting it.

Because health disparities research has often focused on inner-city populations, the special environmental health issues and concerns of other disadvantaged groups are sometimes ignored or overlooked. The research projects undertaken by Rachel Kauffman from Emory University and Kara Koehrn from Duke University focused one such group: children of migrant farmworkers.

Migrant farmworkers are often immigrants who have low literacy and a limited command of English. They are often unaware of the potential health implications of pesticide exposure and other environmental hazards. Many also lack of an awareness of their rights, as well as access to

information and supports that could help protect their health. Because they typically lack access to daycare, they often find it necessary to bring their young children to potentially hazardous worksites. Ms. Kauffman continues to explore how these children face special environmental health risks (e.g., significant exposure to pesticides) due to their parents' employment, as well as the living conditions and limited access to resources typically associated with such work.

Increasing Awareness of Environmental Health Disparities and Environmental Justice

Breaking the cycle of environmental health disparities requires that individuals from a variety of disciplines and backgrounds understand the cycle and take steps to interrupt it. Healthcare providers who understand the dynamics of the cycle and collect information about environmental influences on the health of their patients are better able to practice preventative medicine and provide better healthcare. Professionals working in manufacturing, engineering, planning, and construction, as well as those responsible for the maintenance of residential buildings, schools, and recreational areas, are more likely to engage in environmentally responsible practices if they recognize how their practices affect the children living in those communities. Community leaders who understand the cycle of environmental health disparities are better positioned to effectively educate and empower others as a means of bringing about positive change in communities facing environmental health challenges. Public authorities are more likely to develop and enforce sound environmental health-related laws, regulations, and policies if they understand how both children and whole communities are affected by environmental health hazards and the existence of environmental health disparities.

Spelman College students Brittany Benson, Dominique Bibbins, Deanna McGarity, and Amirah Patterson were already studying the environmental health lessons learned from the Vision 2020 project in Anniston Alabama when they became involved in *Break the Cycle*. Their project showed how introducing students to the cycle of environmental health disparities model and incorporating environmental health case studies into university curricula can raise awareness of environmental health disparities and environmental justice. They also found that including such material increases student interest in pursuing careers or otherwise engaging in activities that related to environmental health.

FINAL COMMENTS

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.

SE PEHSU has demonstrated that *Break the Cycle* is a sustainable, cost-effective catalyst for increasing academic interest and advocacy in issues relating to promotion of children's environmental health. The emphasis of the *Break the Cycle* project is on recruiting graduate and undergraduate

students to become aware of environmental health disparities and cultivate their intellect, interest and creativity to focus on a single project that will make a difference. This encourages the incorporation of 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 who are committed to issues of environmental justice with an 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 to assure safe and healthy environments for all children to grow and develop to their full potential.

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