



# DataSpeak

## Effects of the Built Environment on Maternal and Child Health

November 10, 2014

# Today's Presenters

- **Lynne Messer, PhD, MPH**, from the College of Urban and Public Affairs at Portland State University. Dr. Messer will discuss how she has used data on environmental quality to explore health disparities in reproductive and mental health outcomes.
- **Gary Evans, PhD**, from the College of Human Ecology at Cornell University. Dr. Evans will present research on the effects of environmental factors such as pollution and housing quality on child development and psychological health.

# Previous Events

## DataSpeak Archives

### **2013 Series**

- Findings from the 2011-2012 National Survey of Children's Health
- From Theory to Data to Practice – Practical Applications of the Life Course Approach

# The built environment and women's reproductive health outcomes

(baby's first environmental exposure source)

Lynne C. Messer  
10 November 2014

# Presentation plan

- Motivation
- Conceptual model
- Research description
  - Contextual influences on pregnancy outcomes
    - built environment index construction and results
      - pregnancy behaviors, pregnancy outcomes
      - modifiable areal unit problem
  - Children's environmental health initiative
    - built environment index constructions and results
      - health behaviors
      - psychosocial status (HPHB cohort)
- Limitations
- Strengths

Motivation –  
for research on the built environment

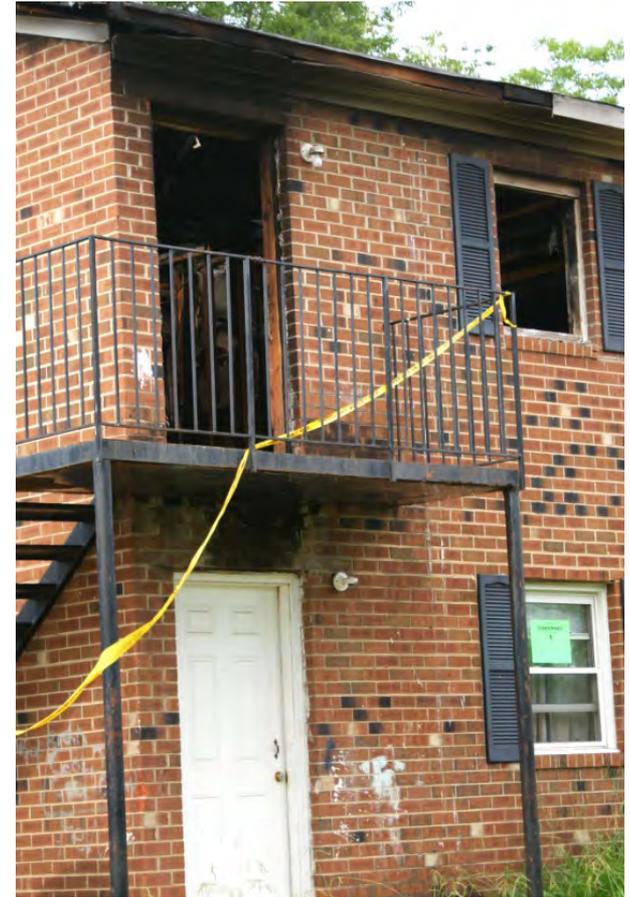
# 1 of 3: Why the built environment?

- Places structure health and health disparities



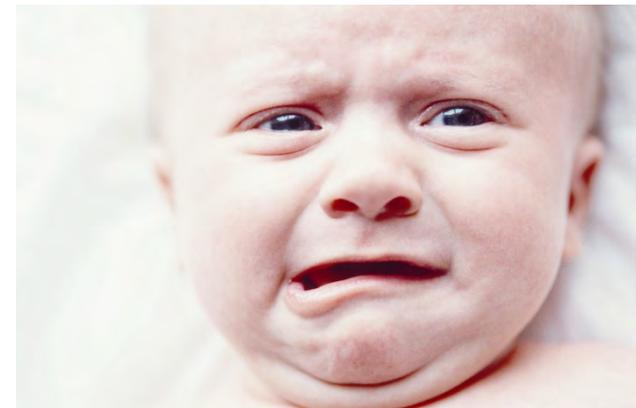
# 2 of 3: Why the built environment?

- Places matter to resident's health
  - contexts are more than the sum of individuals
  - neighborhoods matter to residents
  - contexts are “intervenable” units
  - modest, persistent associations with health demonstrated



# 3 of 3: Why the built environment?

- Thinking about places allows us to consider alternative (non-individual) explanations to persistent disparities
- Preterm birth – a personal problem? (Masset, 2003)
  - 65% of women and 59% of men think premature infants result from a woman's poor self-care during pregnancy
  - almost 75% of respondents thought a woman who delivered preterm could have prevented it



# 1 of 2: Why adverse birth outcomes?



- PTB = birth < 37 weeks' completed gestation
- Important cause of perinatal mortality and morbidity
- PTB had remained largely unchanged or risen steadily since early 80's; rate reduction in recent years
- 2013 lowest rate – 11.4%
- Few established risk factors exist
  - prior PTB, multiple gestations
  - low pre-pregnancy weight, tobacco use, infections
  - single marital status, low ses, gestational bleeding

# 2 of 2: Why adverse birth outcomes?

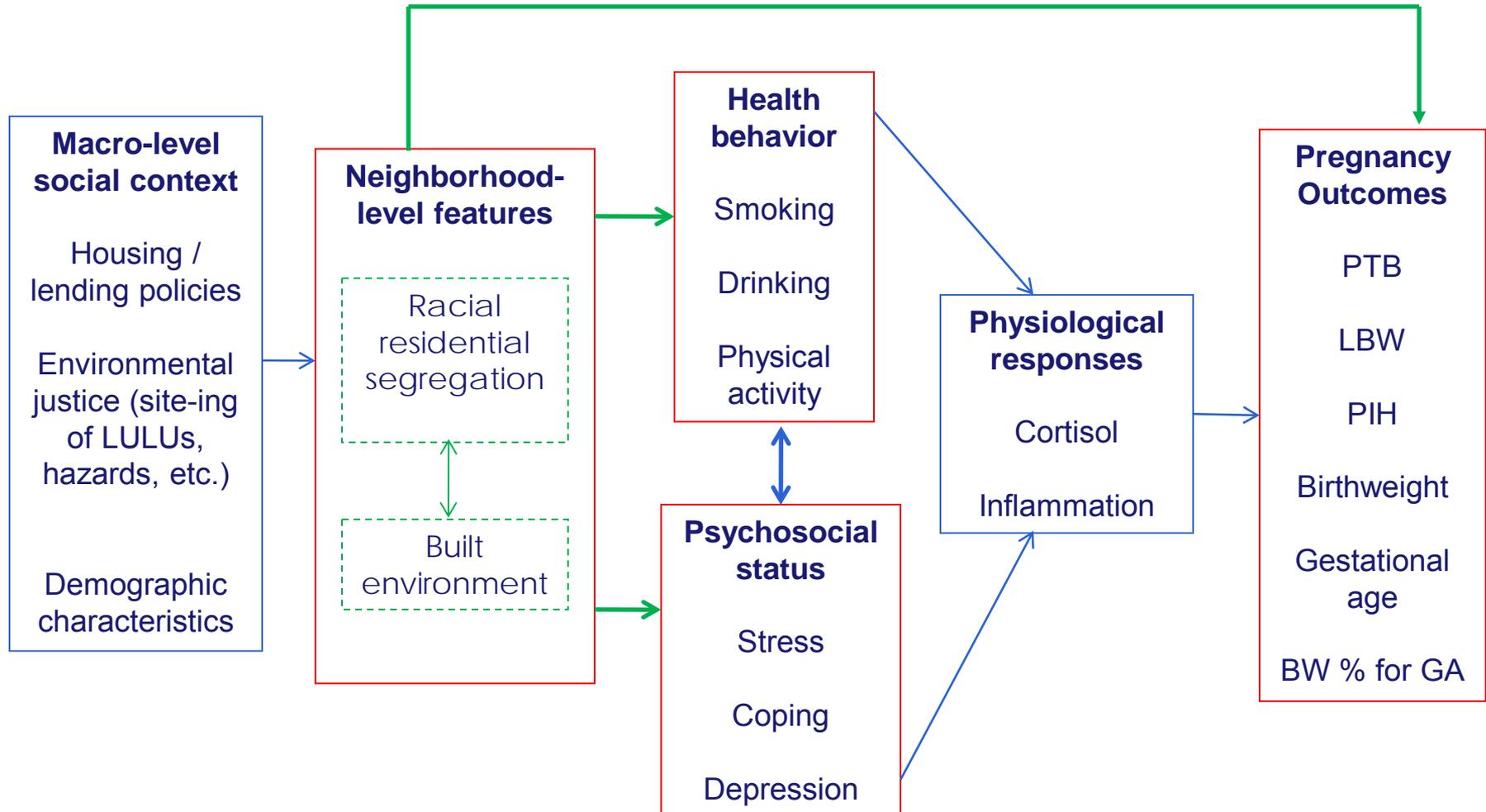
- Significant disparity in preterm births
  - PTB proportion for white women: 10.8%
  - PTB proportion for black women: 17.1% (2010)
- Focus on preterm birth
  - Disparity evident for all other birth outcomes
    - low birthweight
    - term lowbirthweight
    - small for gestational age
    - infant mortality



Conceptual model –  
for the social construction of disparities in pregnancy outcomes

# Conceptual model

- Constructing disparities in birth outcomes



Contextual influences on birth outcomes (CIPO) –  
collecting directly observed built-environment data



- Identify independent associations between five built environment features and maternal behaviors and outcomes
- Assess reliability of indices across multiple units of geographic aggregation
- Explore if observed associations differed by unit of geography at which they were constructed (modifiable areal unit problem)

Evenson, et al., 2009  
Vinikoor, et al., 2012  
Messer, et al., 2012

# CIPO – outcome data source



- Geocoded birth records (2001-2005) for women residing in four NC counties (Alamance, Chatham, Durham, Orange)
- Excluded improbably gestational ages (< 22 weeks', > 42 weeks' completed gestation); improbable weights (< 500g, > 6000g); stillbirths / congenital anomalies
- Restricted to non-Hispanic white (n = 14, 531) and non-Hispanic black (n=8773) births

# CIPO – built environment data collection

- 4 counties; 1843 square miles; 7150 road miles
- 10-member trained team; inter-rater reliability assessed biweekly
- Street segment – one block face, both sides of street
- Street segments rated daily; May – August 2008
  - pairs of raters assessed from car; 9:00 a.m. – 4:00 p.m.
  - 10,770 street segments (25.8% of total segments)
  - 43 variables assessed

Evenson, et al., 2009

Vinikoor-Imler, et al., 2012

Messer, et al., 2012



# CIPO – constructs represented

- Physical incivilities – markers of neglect; leads to decreased confidence in neighborhood social control
- Walkability – properties of streets; neighborhoods that facilitate movement
- Social spaces – places to gather; promotes social cohesion and neighborhood identity
- Territoriality – physical, symbolic barriers; may decrease crime fear, increase social control
- Arterial features – properties of roadways designed to move people



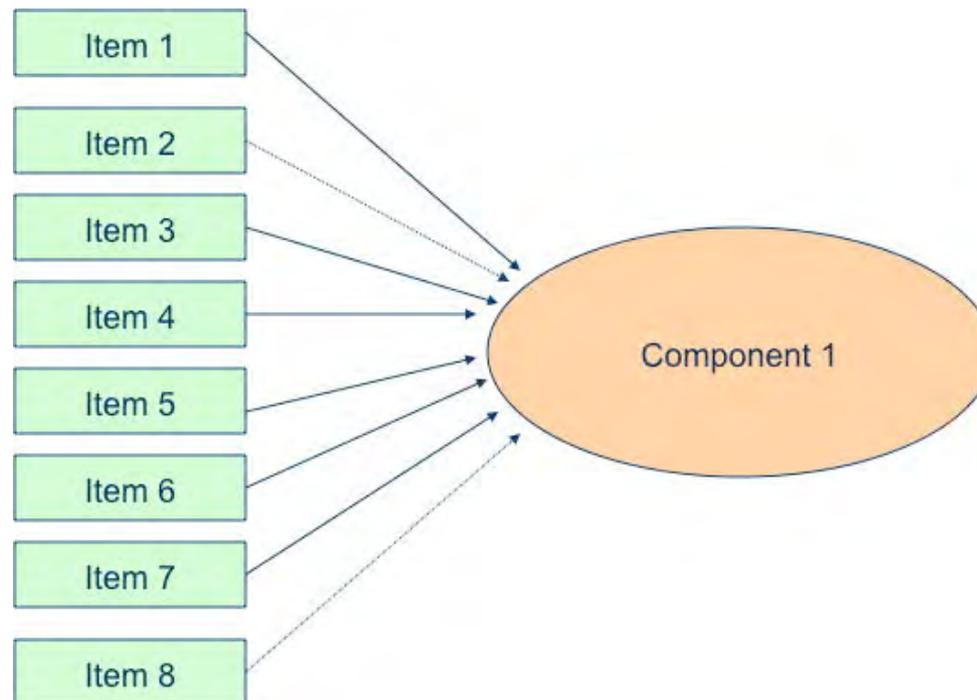
# CIPO – built environment indices

Physical incivility BG $\alpha = .86$	Walkability BG $\alpha = .81$	Social Spaces BG $\alpha = .74$	Territoriality BG $\alpha = .72$	Arterial features BG $\alpha = .82$
<ul style="list-style-type: none"> <li>• Condition of rental units</li> <li>• Condition of residential grounds</li> <li>• Burned/abandoned units</li> <li>• Presence of litter</li> <li>• Pedestrian-oriented lighting</li> <li>• No trespassing sign</li> </ul>	<ul style="list-style-type: none"> <li>• Neighborhood park/playground</li> <li>• Sidewalk in good condition</li> <li>• Pedestrian-oriented lighting</li> <li>• Neighborhood entrance sign</li> </ul>	<ul style="list-style-type: none"> <li>• Presence of porches</li> <li>• Presence of sidewalks</li> <li>• Traditional or landscaped lawn</li> <li>• Visible adult or child outside</li> </ul>	<ul style="list-style-type: none"> <li>• Presence of decoration</li> <li>• Presence of border</li> <li>• Presence of porches</li> </ul>	<ul style="list-style-type: none"> <li>• Non-residential land use</li> <li>• Sidewalk in good condition</li> <li>• Bus stop/facilities</li> <li>• Over 2 lanes to cross</li> <li>• Paved roads</li> <li>• Crosswalk/marked road</li> <li>• Pedestrian yield markings</li> </ul>

BG  $\alpha$  = Cronbach's alpha calculated at block group  
 Evenson, et al., 2009  
 Vinikoor-Imler, et al., 2012  
 Messer, et al., 2012

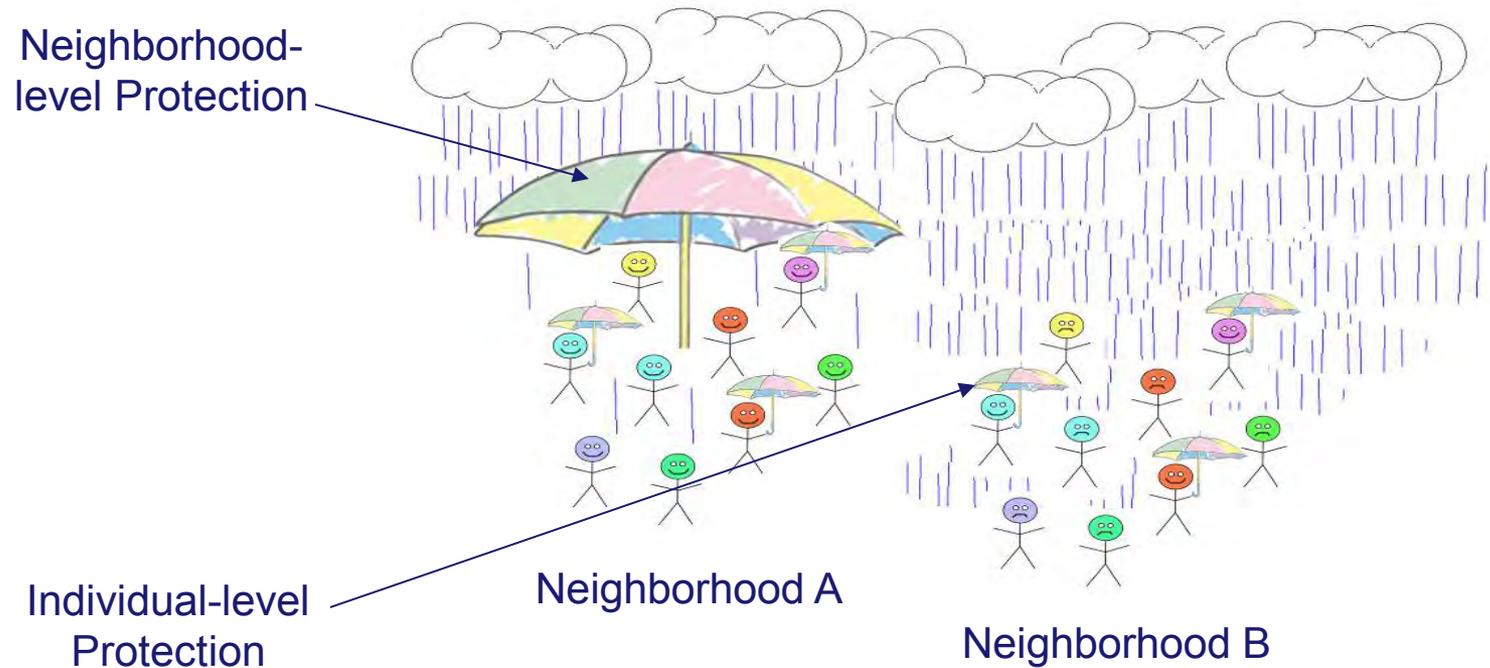
# CIPO – data reduction methods

- Census block groups approximated neighborhood environments for this analysis
- Only contextual units (block groups) with >20% of street segments audited were included in the analysis
- PCA used to empirically summarize indices



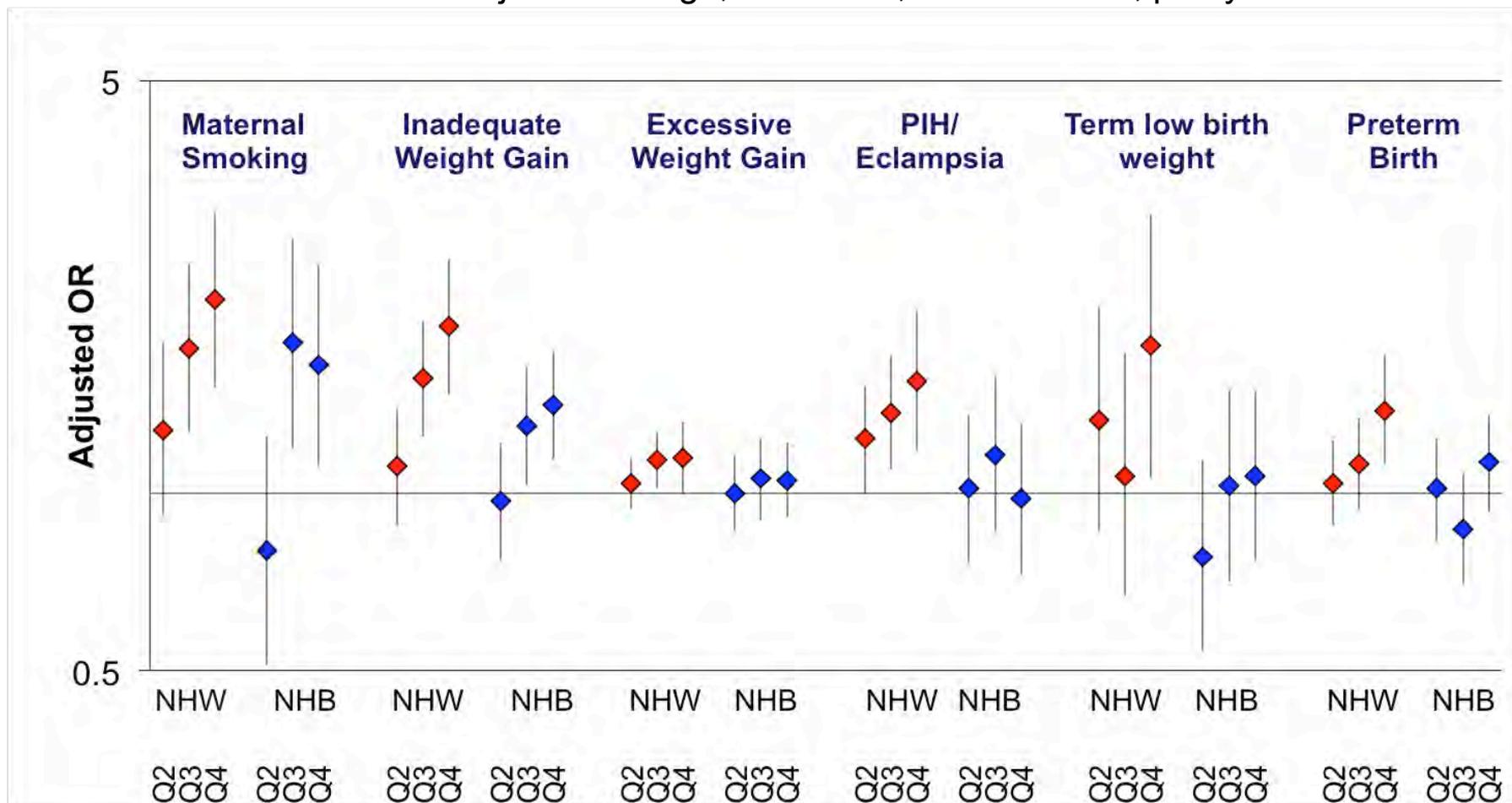
# CIPO – data analysis

- Fixed slope random intercept multilevel logistic models (adjusted for maternal age, education, marital status, parity)
- Quartiles of each index used in analyses



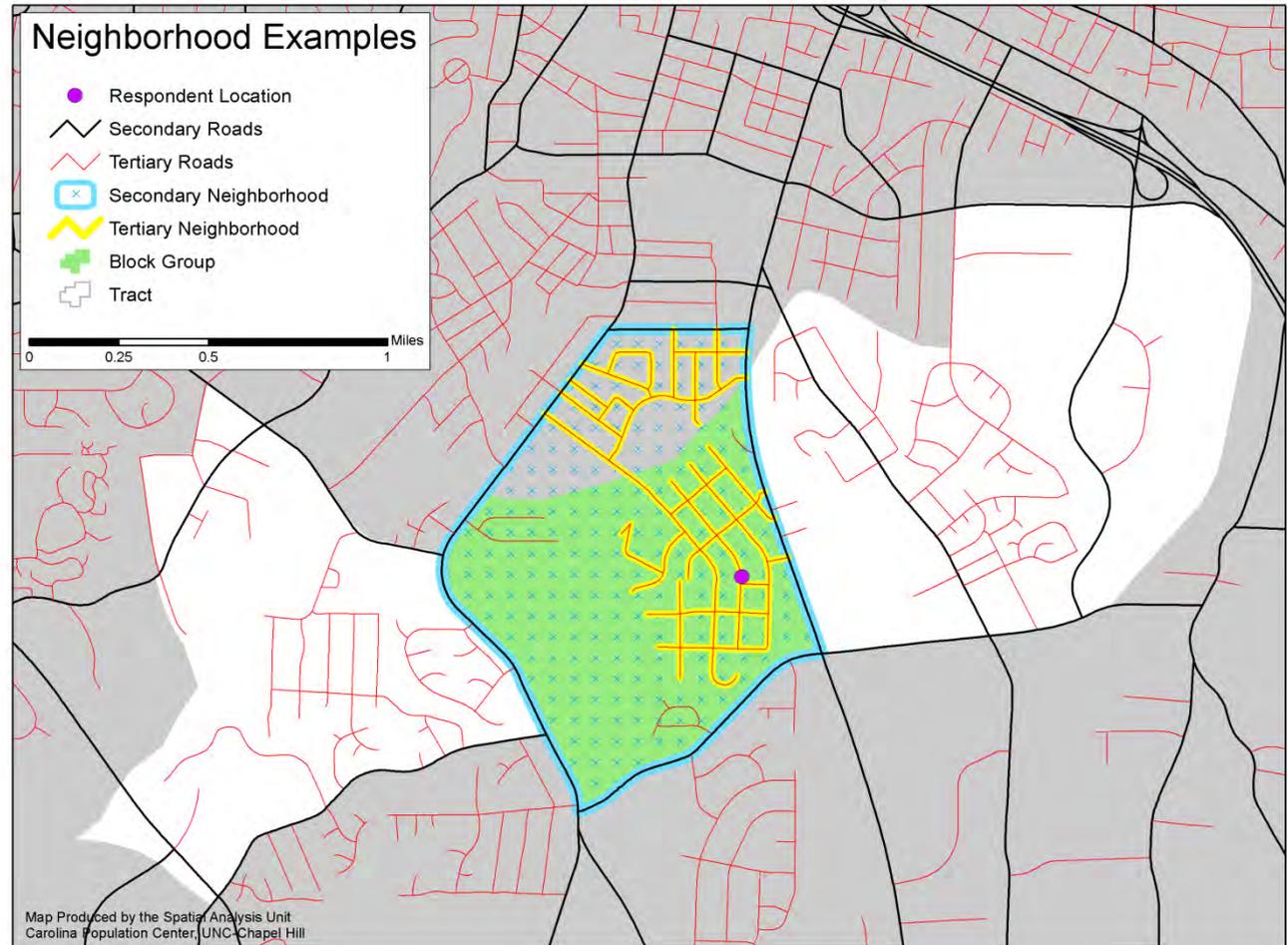
# CIPO – incivilities, health behaviors, outcomes

Race-stratified models adjusted for age, education, marital status, parity



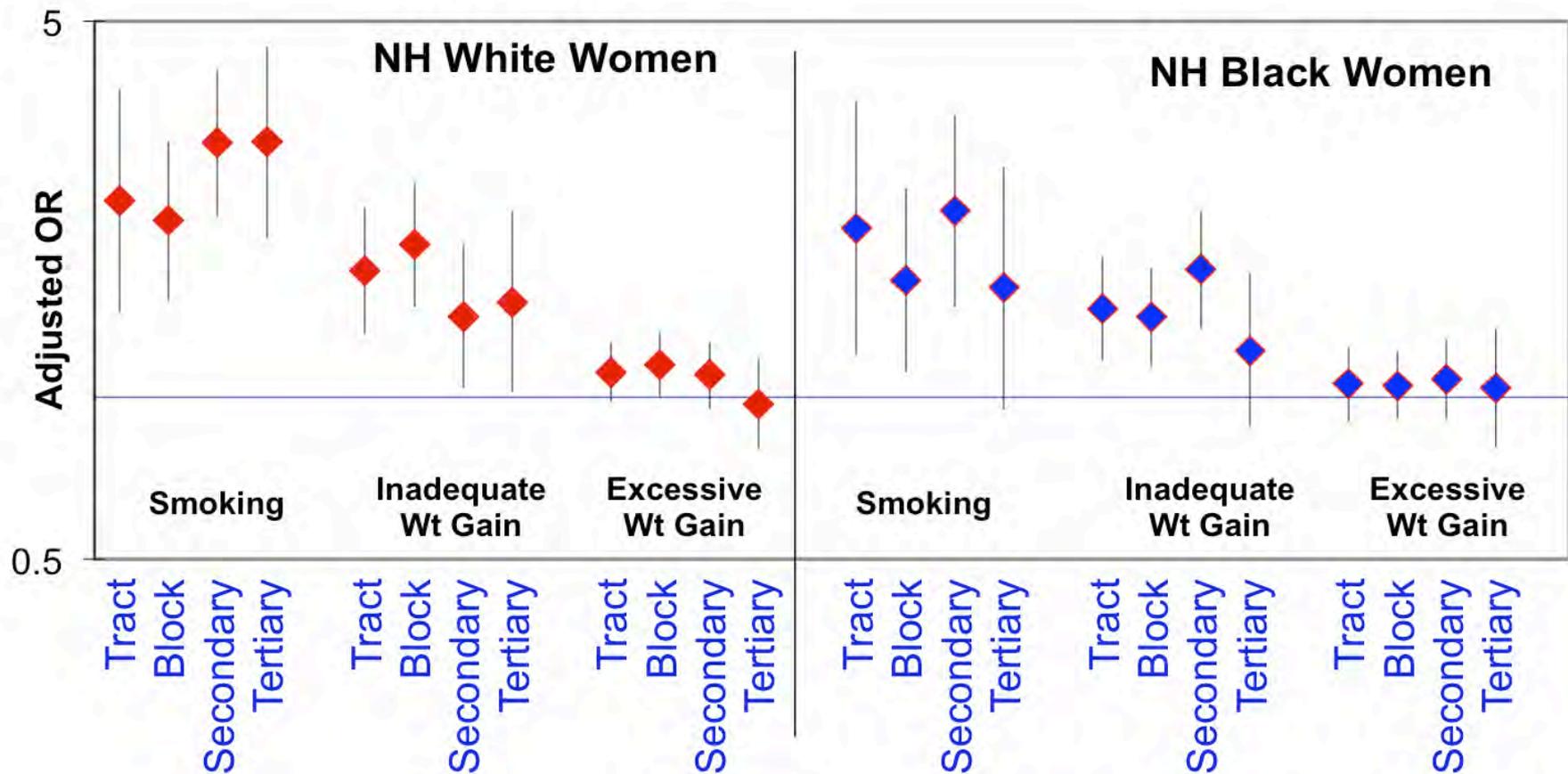
# CIPO – assessing MAUP

- Recognize block group not necessarily neighborhood
- Census tract, block group, secondary polygon, tertiary neighborhood
- Indices constructed at each unit of geography



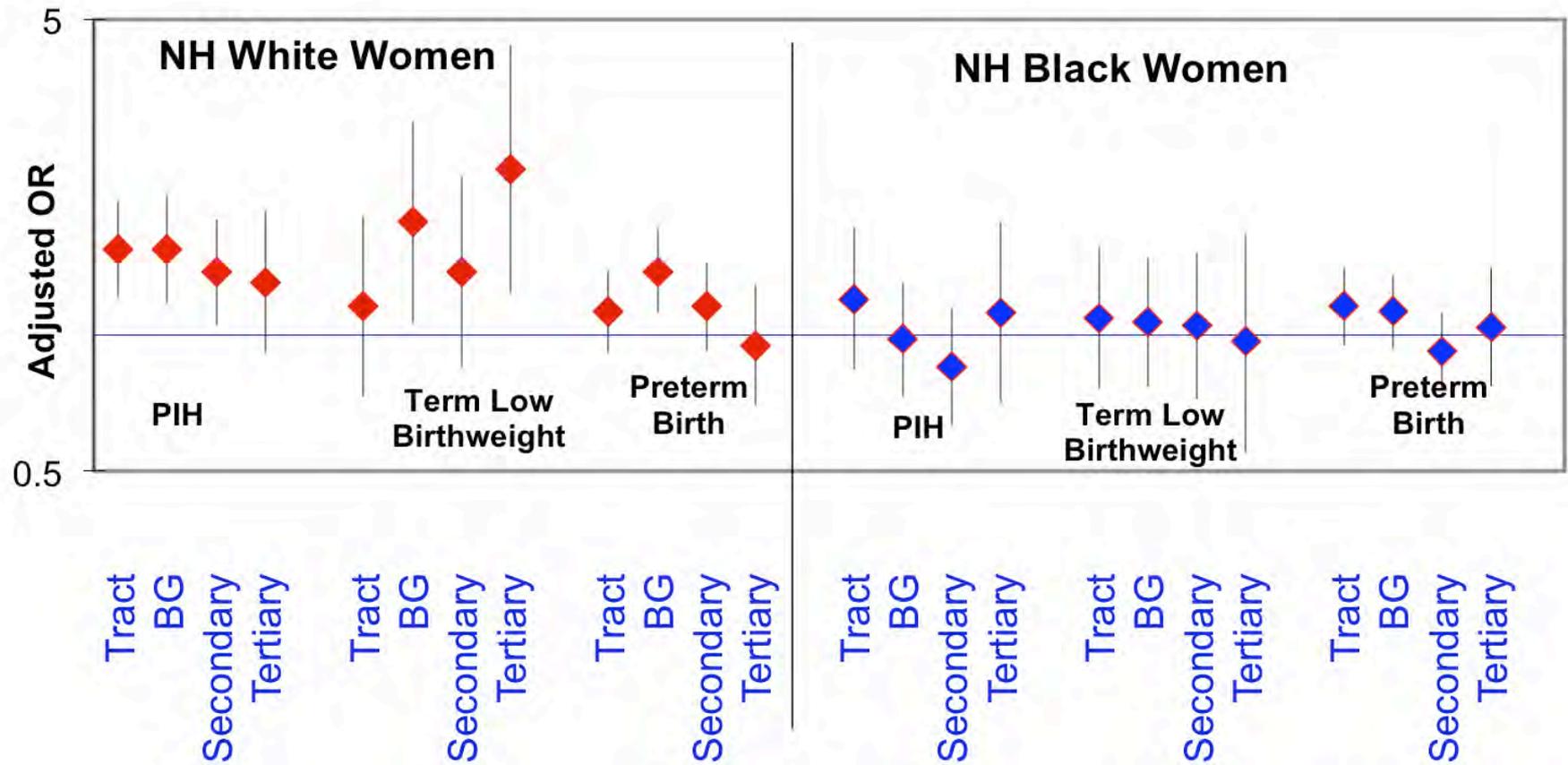
# CIPO – physical incivilities, health behaviors

Race-stratified models adjusted for age, education, marital status, parity



# CIPO – physical incivilities, health outcomes

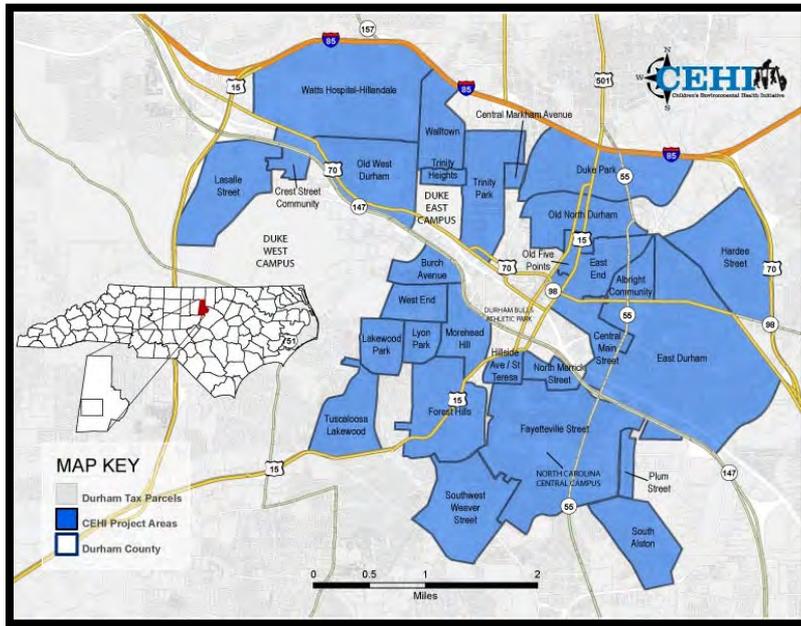
Race-stratified models adjusted for age, education, marital status, parity



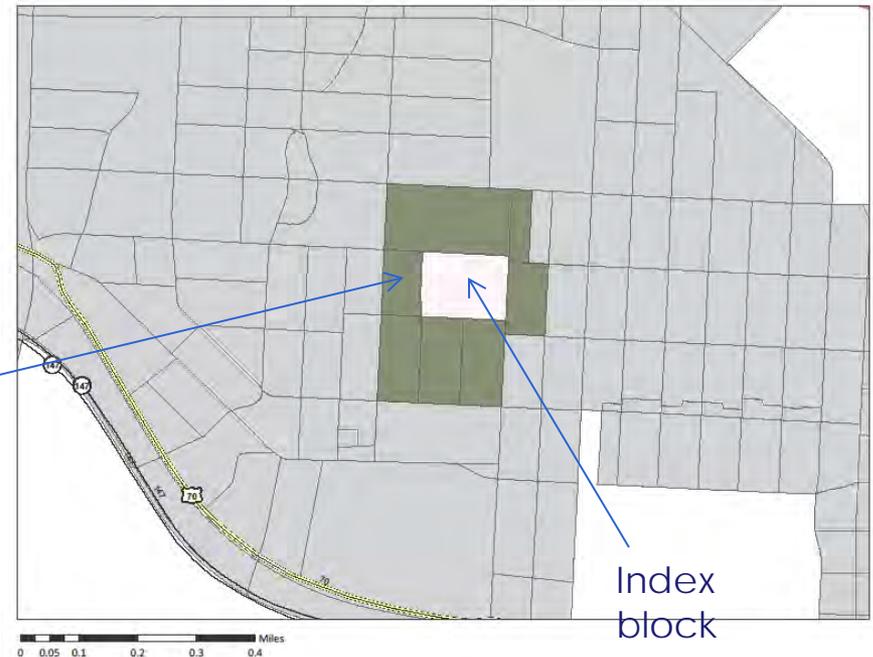
Built environment and maternal health behaviors  
and psychosocial status –  
children's environmental health initiative

# CEHI – data collection, neighborhood definition

- Community Assessment Project – collected built environment data on Durham tax parcels located in neighborhoods
- On foot; 7:00 a.m. – 1:30 p.m.; May – August 2008



Primary adjacency community



# CEHI – variable representation

Housing Damage	Property Damage	Security Measures	Amenities	Tenure	Vacancy	Crime
<ul style="list-style-type: none"> <li>• Boarded door</li> <li>• Holes in walls</li> <li>• Roof damage</li> <li>• Chimney damage</li> <li>• Foundation damage</li> <li>• Entry damage</li> <li>• Door damage</li> <li>• Peeling paint</li> <li>• Fire damage</li> <li>• Condemned</li> <li>• Broken Windows</li> </ul>	<ul style="list-style-type: none"> <li>• Cars on lawn</li> <li>• No grass</li> <li>• Standing water</li> <li>• Litter</li> <li>• Garbage</li> <li>• Broken glass</li> <li>• Discarded furniture</li> <li>• Discarded appliances</li> <li>• Discarded tires</li> <li>• Inoperable vehicles</li> <li>• High grass or weeds</li> </ul>	<ul style="list-style-type: none"> <li>• Security bars</li> <li>• Barbed wire</li> <li>• Sign: no trespassing</li> <li>• Sign: beware of dog</li> <li>• Security sign</li> </ul>	<ul style="list-style-type: none"> <li>• Schools</li> <li>• Libraries</li> <li>• Faith institutions</li> <li>• Day care centers</li> <li>• Health care providers</li> <li>• Grocery stores</li> <li>• Parks</li> <li>• Community Centers</li> </ul>	<ul style="list-style-type: none"> <li>• Owner-occupied</li> <li>• Renter-occupied</li> </ul>	<ul style="list-style-type: none"> <li>• Vacant commercial</li> <li>• Vacant residential</li> <li>• Vacant empty lot</li> </ul>	<ul style="list-style-type: none"> <li>• Robberies</li> <li>• Homicide</li> <li>• Assault</li> </ul>

# CEHI – built environment and maternal behavior

Models adjusted for age, education, marital status	Smoking WNH	Smoking BNH	Hypertension WNH	Hypertension BNH	Weight gain WNH	Weight gain BNH
Housing damage	2.1 (0.8, 6.0)	1.2 (1.1, 1.4)	0.6 (0.1, 6.0)	0.5 (0.2, 1.1)	-0.9 -2.7, 0.8	-0.7 -1.6, 0.3
Property disorder	1.7 (1.1, 2.6)	1.3 (1.1, 1.5)	1.1 (0.4, 2.6)	0.8 (0.6, 1.2)	-1.8 -3.5, -0.0	-0.3 -1.2, 0.6
Security measures	1.1 (0.6, 2.0)	1.0 (0.8, 1.1)	1.7 (0.8, 3.8)	0.8 (0.5, 1.1)	0.4 -1.2, 2.0	-0.9 -1.9, -0.0
Tenure	1.0 (0.6, 1.6)	1.3 (1.1, 1.6)	0.8 (0.4, 1.6)	0.7 (0.5, 1.0)	-0.4 -1.8, 1.0	-0.4 -0.7, 1.4
Vacancy	1.5 (0.9, 2.7)	1.3 (1.1, 1.5)	1.1 (0.4, 2.8)	0.9 (0.6, 1.4)	-0.7 -2.7, 1.3	-0.8 -1.8, 0.3
Violent crime	1.1 (0.9, 1.2)	1.0 (0.9, 1.1)	0.7 (0.3, 1.8)	1.0 (0.9, 1.1)	-0.6 -1.3, 0.2	-0.3 -0.7, 0.1
Nuisances	1.0 (0.7, 1.4)	1.2 (1.0, 1.3)	0.7 (0.3, 1.6)	1.1 (0.9, 1.3)	-1.3 -2.6, -0.1	-0.4 -0.9, 0.2

Odds ratios (95% CI) for dichotomous smoking, hypertension; beta coefficients (95% CI) for continuous weight gain

Healthy Pregnancy – Healthy Baby  
Prospective cohort based in Durham, NC  
Children’s Environmental Health Initiative



# CEHI – HPHB methods

- Healthy Pregnancy – Healthy Baby (HPHB)
  - prospective cohort study of pregnant women in Durham NC
  - designed to assess the joint contributions of genetic, environmental and social factors on birth outcomes
- Recruiting women (18-28 weeks' gestation) from:
  - Durham County Health Department clinic
  - Duke Obstetrics Clinic
- Exclusions:
  - < 18 years of age
  - not English literate
  - > 28 weeks' gestation
  - multiple gestation
  - known abnormality
  - not planning to deliver at Duke



# CEHI – HPHB sample description



- Ongoing study enrollment (began June 2005)
- 90% consent rate; 92% retention rate at delivery
- 104 lost to follow-up, 25 withdrawn due to screening failure, 18 voluntarily withdrawn
- As of December 2010
  - 1743 women enrolled with pregnancy outcome data
  - 1188 non-Hispanic black
  - 332 non-Hispanic white
  - 108 Hispanic
  - 111 Asian plus others
- 723 lived in audit area

# CEHI – HPHB psychosocial scale description

Psychosocial construct	Mean (sd)	Range
Interpersonal support evaluation list - total	37.1 (8.1)	7 to 48
Self efficacy	3.3 (0.5)	1 to 4
Centers for epidemiologic studies depression scale	15.6 (10.7)	0 to 58
John Henryism active coping scale	51.2 (6.1)	24 to 60
Perceived racism scale	0.6 (1.1)	0 to 6
Perceived stress score	2.6 (0.7)	1 to 4.6
Negative paternal support	1.2 (0.3)	0.8 to 3.0

- PCA used for index construction
- Neighborhood-level indices; dichotomized at median
- Tertiles of each psychosocial index constructed, except for perceived racism and depression
- Models adjusted for maternal race, age, education, marital status, insurance and parity



# CEHI – built environment, psychosocial summary

- In unadjusted models comparing upper to lower tertiles of built environmental indices, women who lived in PACs with –
  - more *housing damage* reported higher perceived stress score
  - more *property disorder* reported more negative paternal support, perceived stress score, and depression
  - more *renters* reported higher John Henryism, negative paternal support and more perceived racism
  - more *vacant* properties reported less interpersonal support
  - more *violent crime* reported less social support
  - more *nuisances* reported more perceived racism
  - *security measures* was largely not associated with maternal psychosocial health
- Following adjustment, *tenure* remained statistically significantly associated with John Henryism and negative paternal support.



Strengths and limitations

# Built environment research limitations

- BE data collection – still not certain all influential components of neighborhood conditions assessed; not an areal census
- Birth records – quality of some birth record data elements can be questionable; length of time at residence not known
- HPHB cohort – somewhat limited in generalizability; <28 weeks' cutpoints means early pregnancy experiences / losses may not be represented



# Built environment research strengths



- BE data – data collection methodology thorough and easily replicable; entire communities assessed, not just sampled; large number of variables representing theoretically relevant domains assessed
- Birth records – large numbers of women of many races ensures adequate numbers for most statistical modeling approaches; high geocoding success; used data reliable data elements.
- HPHB cohort – prospective cohort so outcomes occurred after exposure assessment; large number of validated psychosocial scales assessed.

# Current work and future directions

- Under contract with the Environmental Protection Agency, we constructed a county-level environmental quality index (PI: Danelle Lobdell)
  - air, water, land, built and sociodemographic domains
  - domain-specific and overall EQI for 3141 U.S. counties
  - indices, data about to become publically availal
- Papers in progress:
  - preterm birth and environmental quality (Rappazzo, et al.)
  - adverse birth outcome disparities (very preterm birth, term low birthweight) and environmental quality (Messer, et al.)
  - cancer and environmental quality (Jagai, et al.)



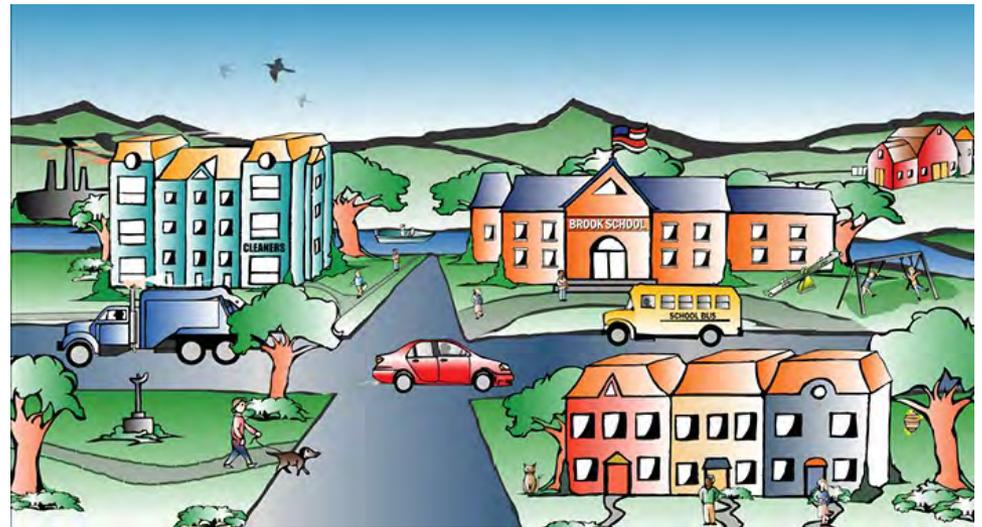
Lobdell, et al., 2011  
Jagai, et al., 2013  
Messer, et al., 2014

# Acknowledgements

- CIPO
  - Department of Health and Human Services, Health Resources and Services Administration, Maternal & Child Health Bureau (#1 R40MC07841-01-00)
  - Data collection was supported by the National Institutes of Health (NIH)/National Cancer Institute (#CA109804).
- CEHI
  - Funding: US Environmental Protection Agency (RD 83329301)
- EQI
  - EPA contracts ED09D000003, EP12D000264



Thank you and questions

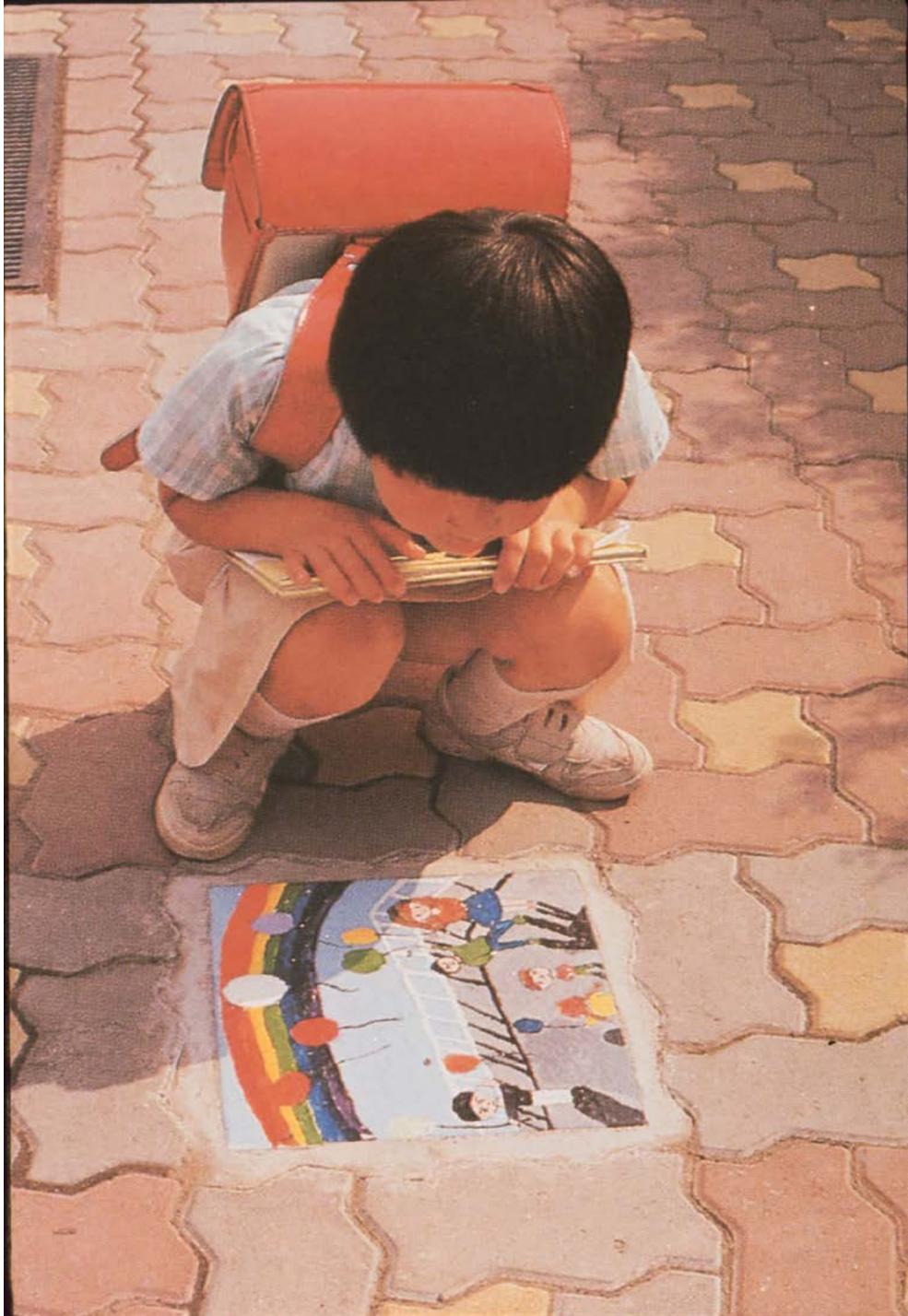


# EARLY CHILDHOOD AND THE BUILT ENVIRONMENT

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November 10, 2014





# Traditional Perspective

- Toxicology
- Safety/hazards





# Loose Parts









# Scaffolding





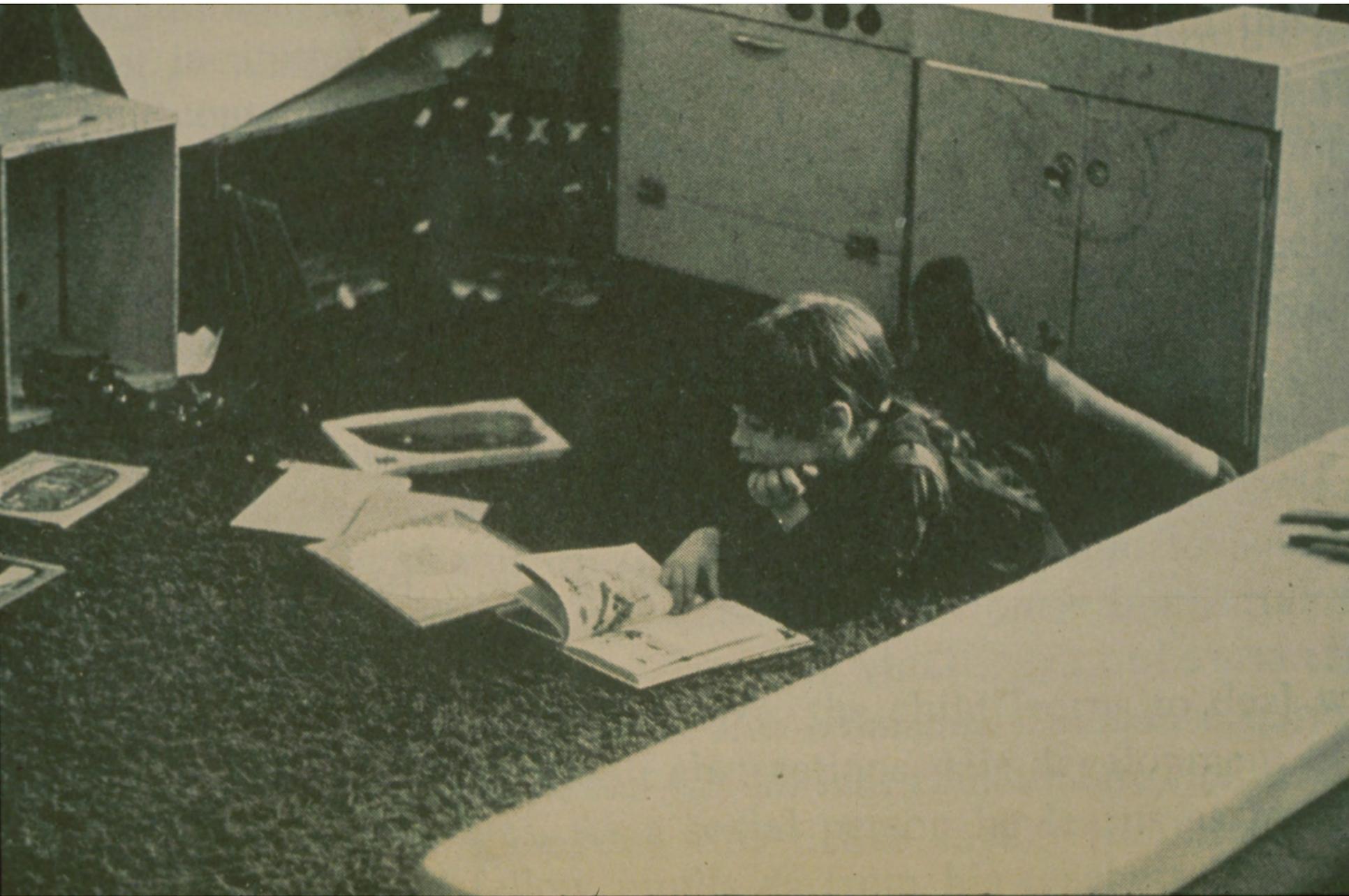


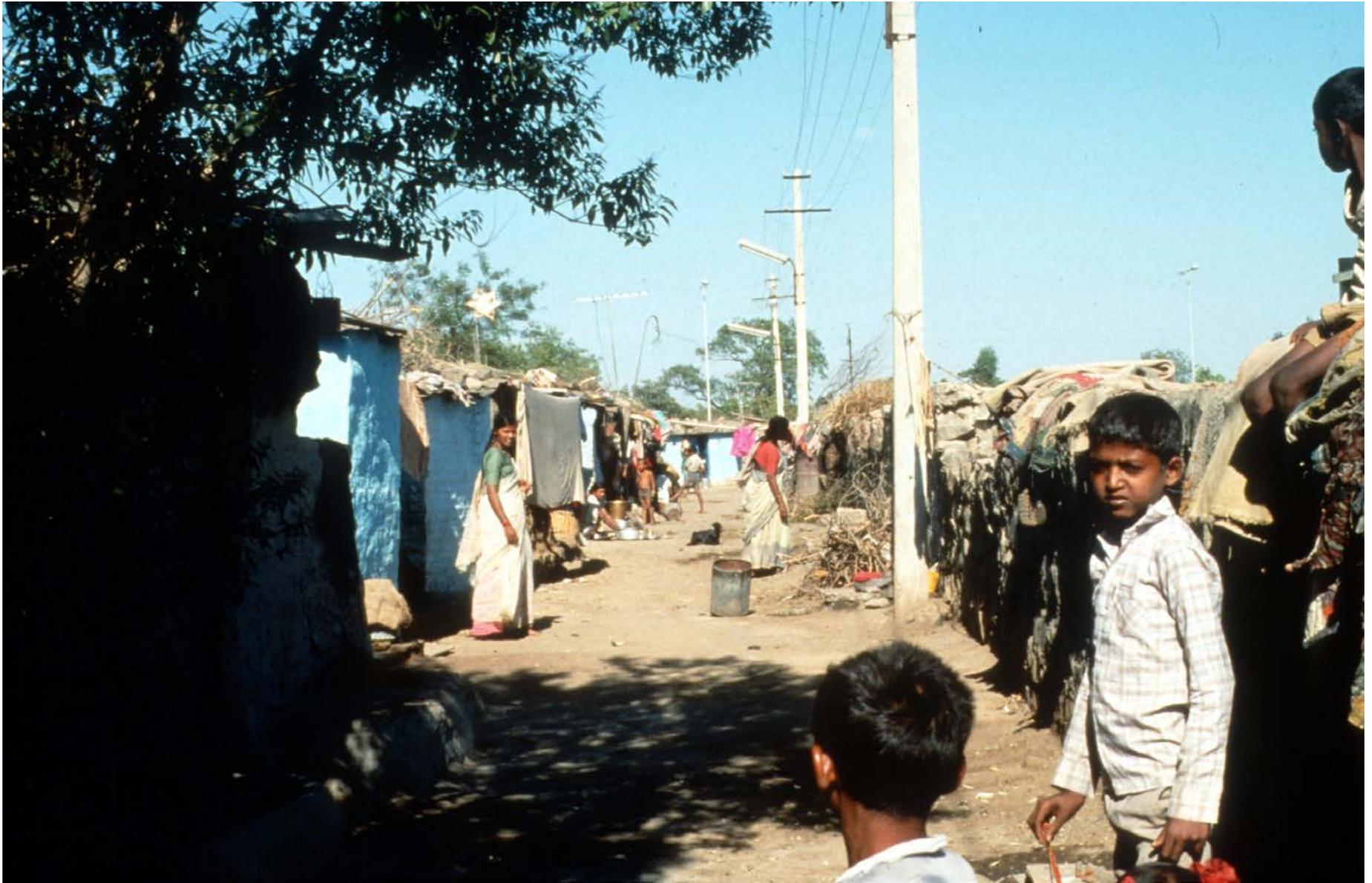
Nancy Rudolph



Playground

# Privacy



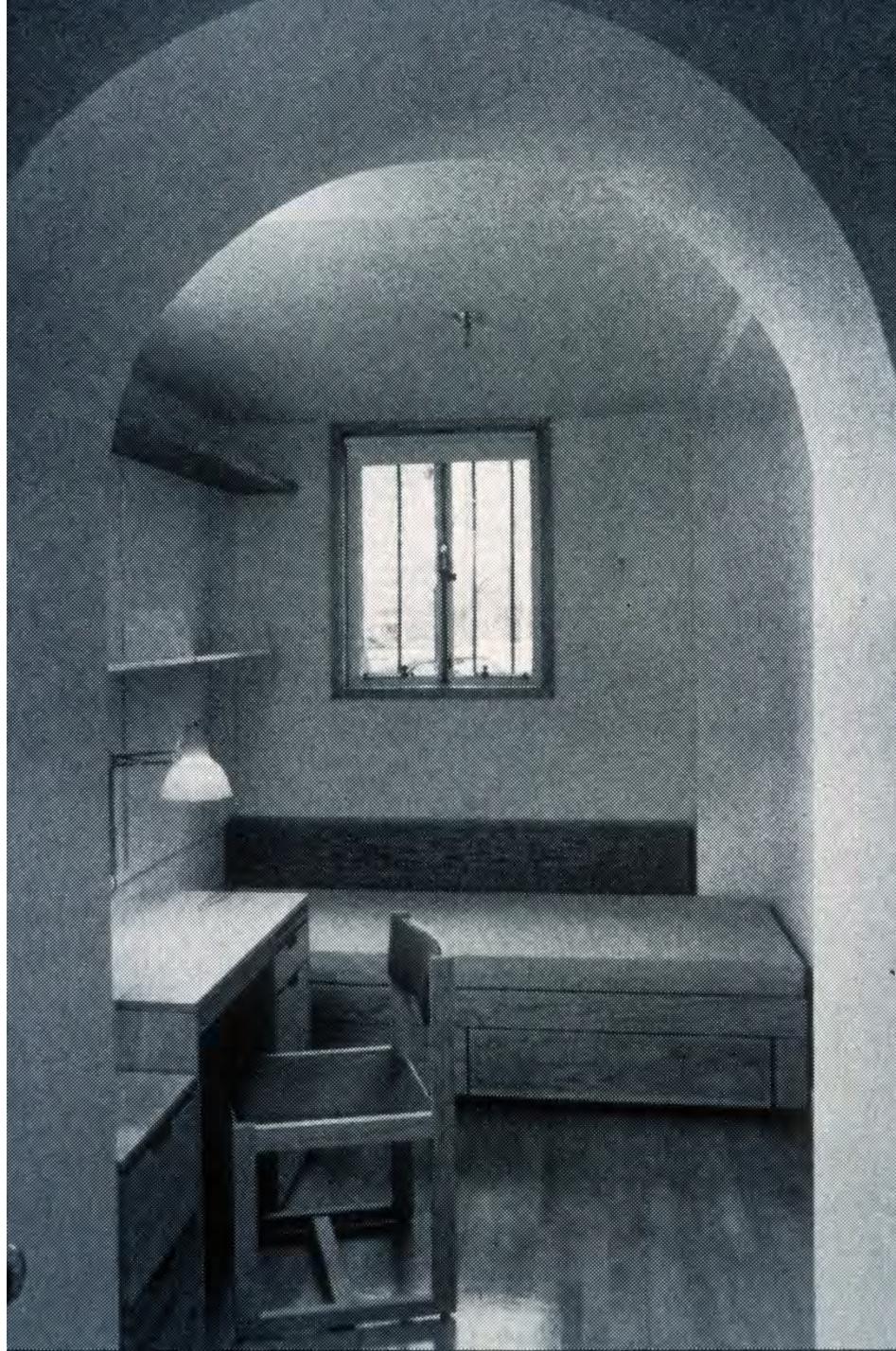






# Attachment

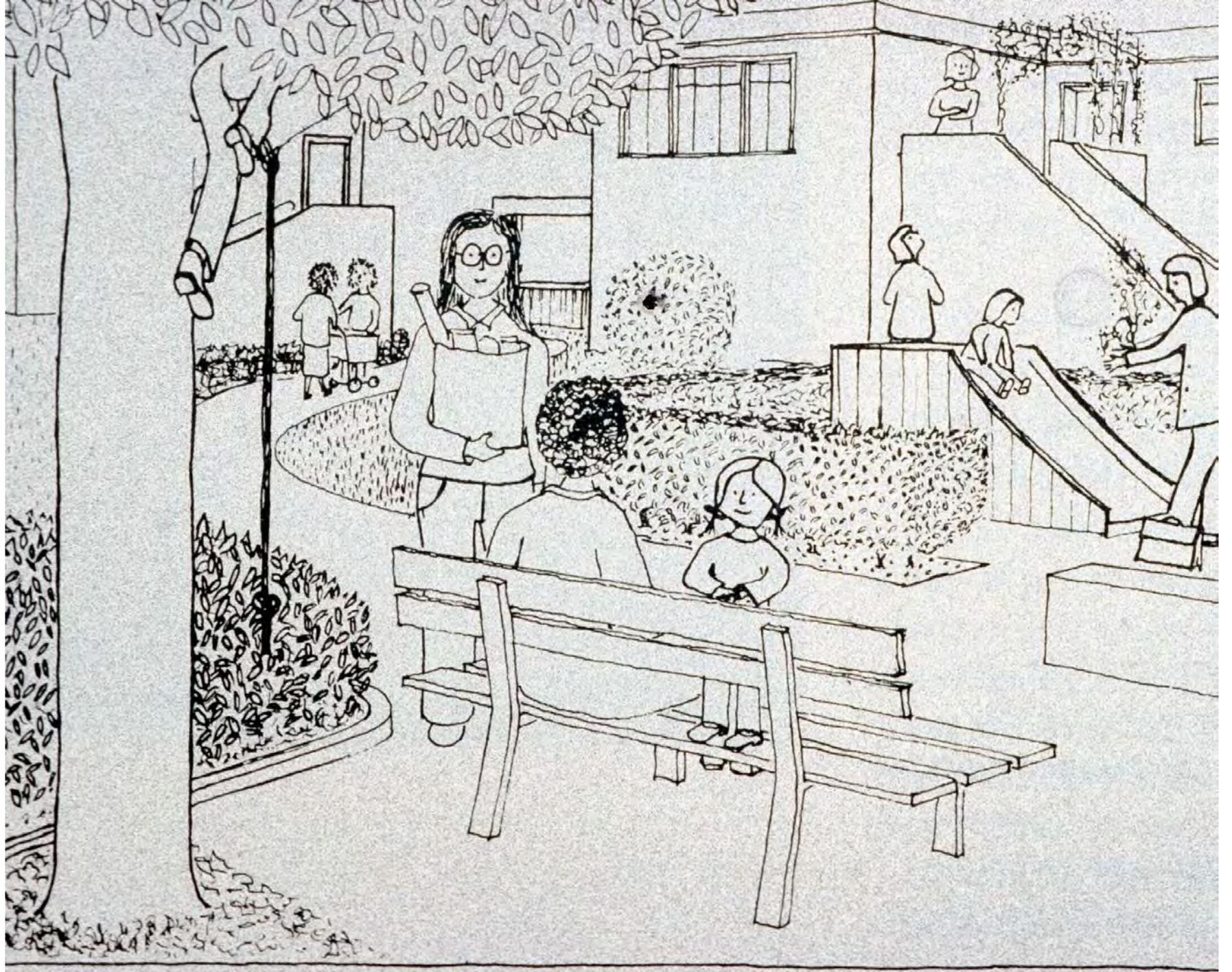














# Chaos





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# Restoration









# Control & Mastery









# Summary

- Traditional  
    Toxicology  
    Safety/Hazards
- Loose Parts
- Scaffolding
- Attachment
- Chaos
- Restoration
- Control/Mastery

# Questions

**[dataspeak@altarum.org](mailto:dataspeak@altarum.org)**

# Thank You

Thank you for participating.

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