Pollution and Low-Income Children's Development Across Urban, Suburban, and Rural Communities

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Poverty and Early Child Development

- Child poverty has negative links with development:
  - Achievement and attainment
  - Behavioral functioning
  - Health
- Evidence suggests poverty *causes* detriments in functioning

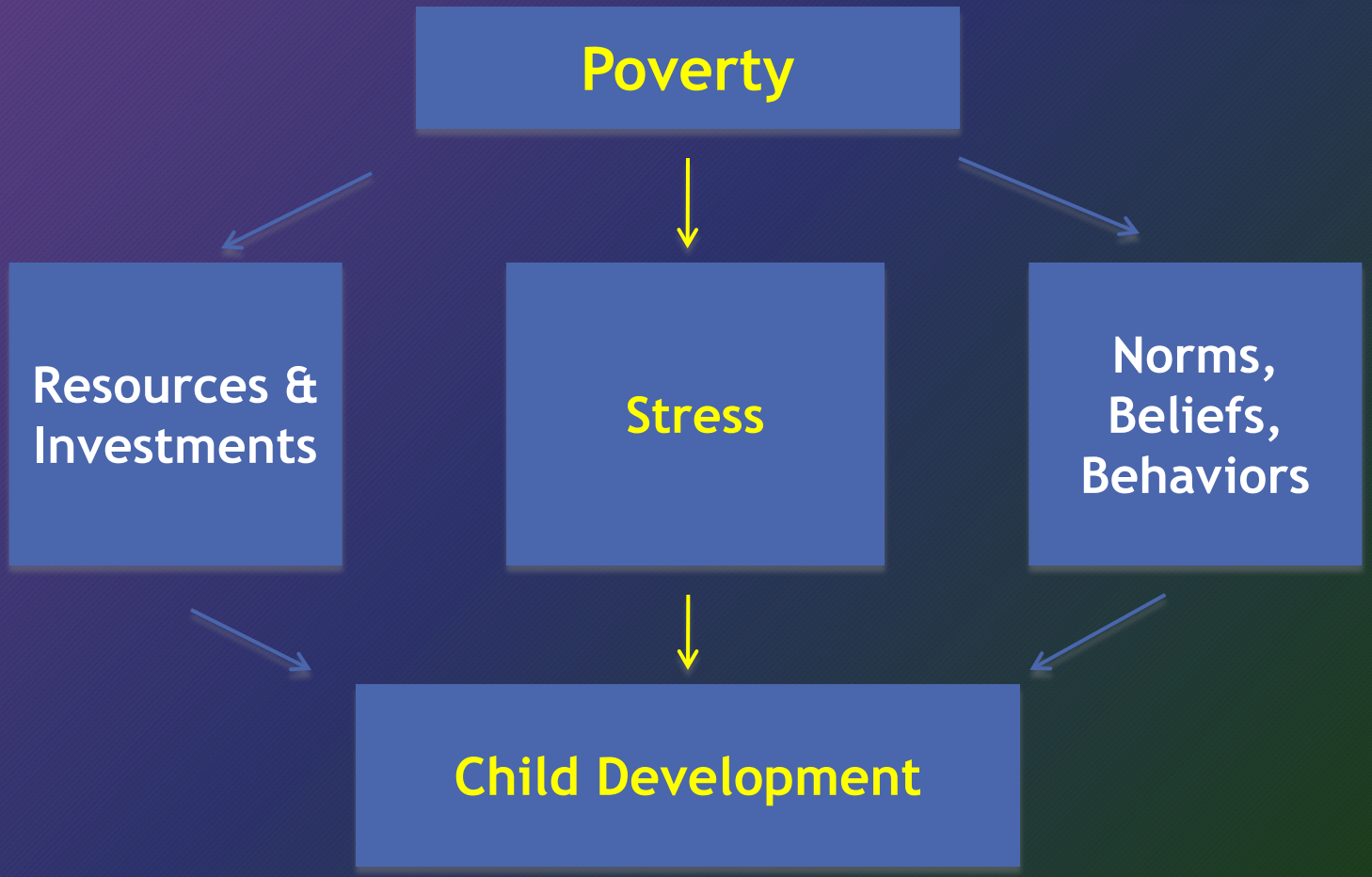
Poverty Dispersion in the U.S.

- Poor families are dispersed across urban, suburban, & rural areas
  - Child poverty rates highest in central cities and rural areas
  - Suburban poverty rising at rates greater than in central cities or rural areas
  - Suburbs now home the greatest number of poor families

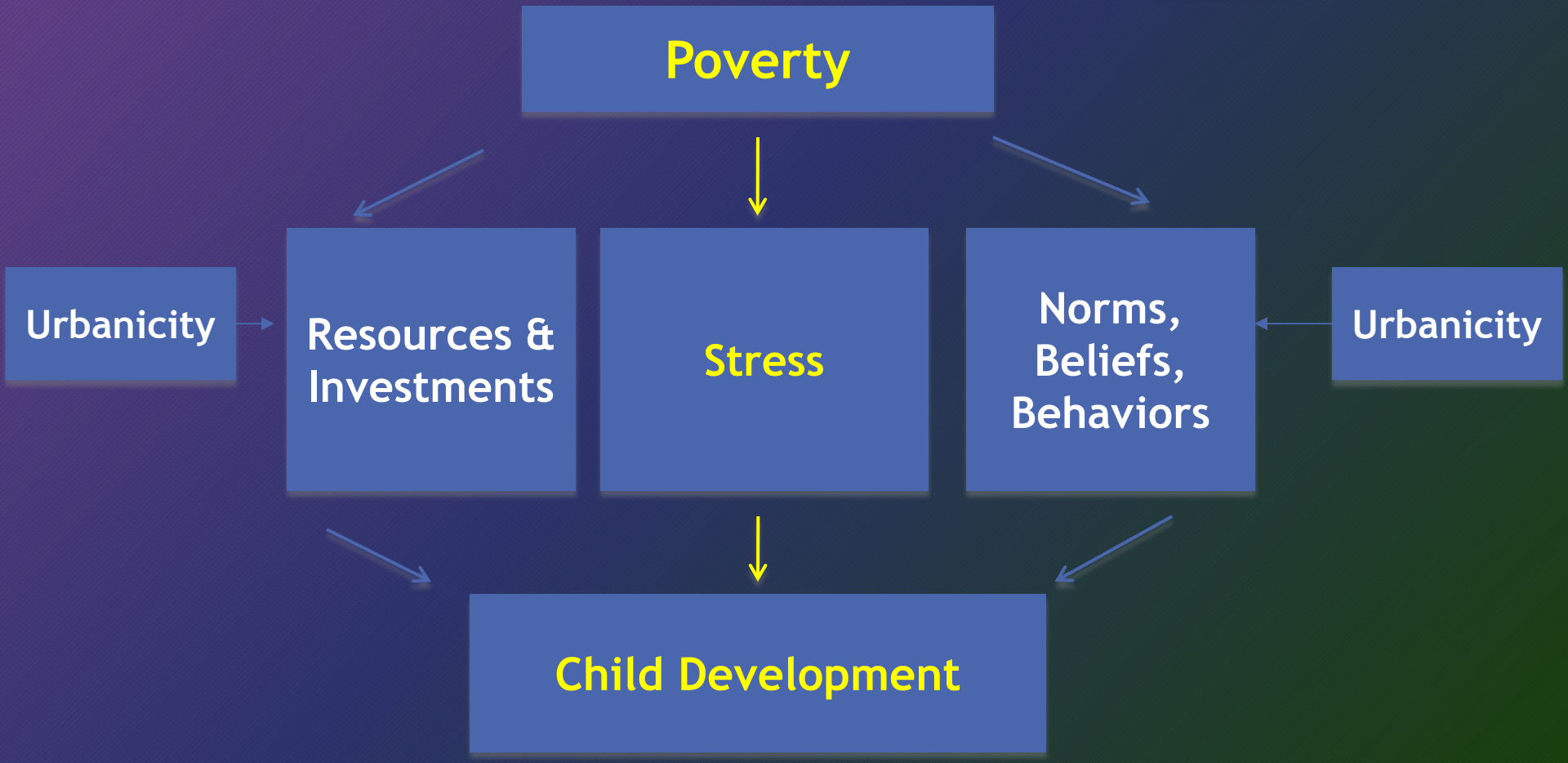
Poverty and Development Across the Urban-Rural Continuum

- Few studies consider differences in links between poverty and development across urbanicity
- The urban to rural continuum represents unique contexts development
  - Population density
  - Access to resources
  - Physical/environmental stressors
  - Concentrated disadvantage
  - Socioeconomic integration

How does poverty affect development?



How might urbanicity alter poverty-development links?



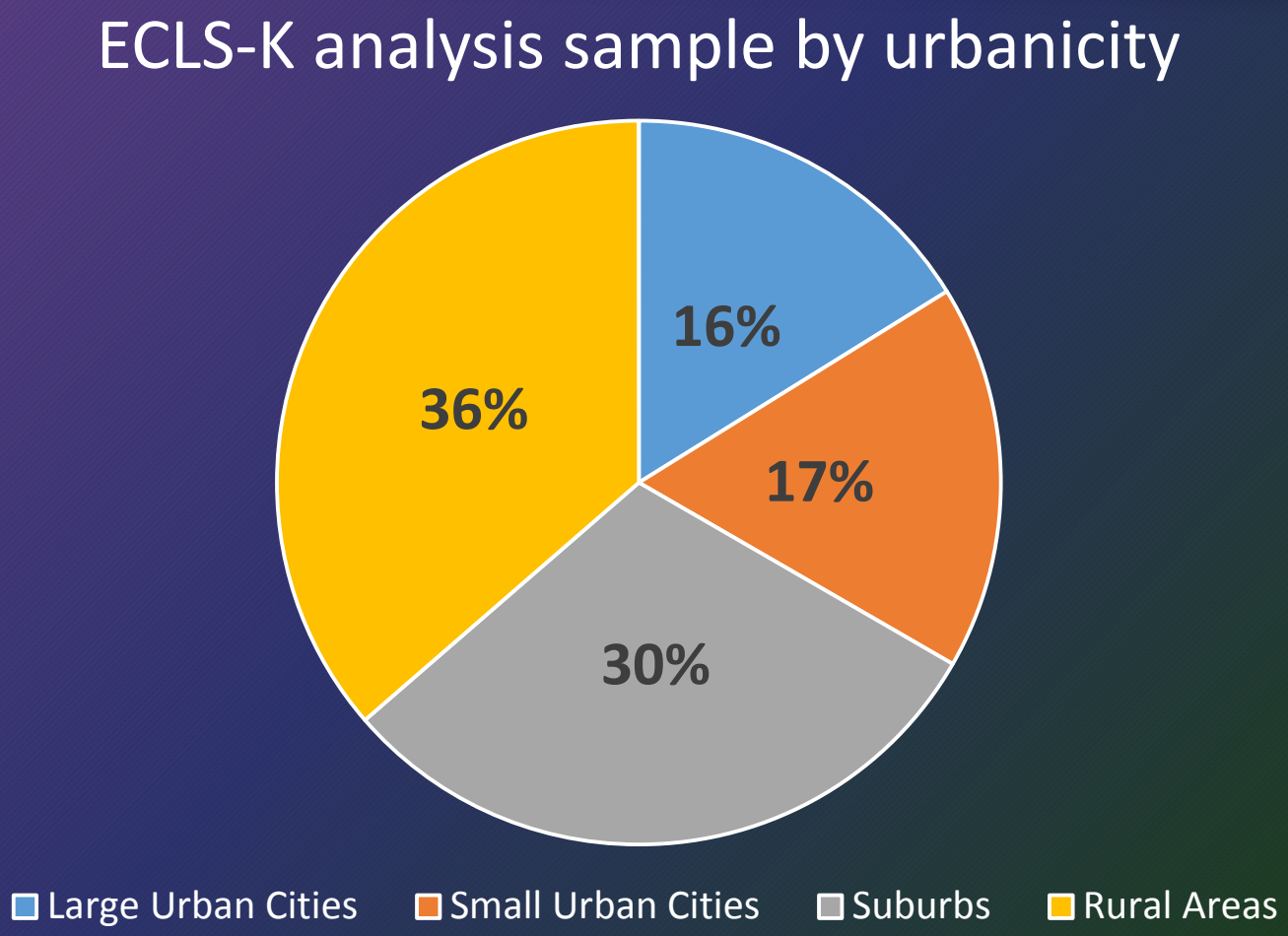
Research Aims

- Are there differences in low-income children's health and academic and behavioral functioning across urban, suburban, and rural communities?
- Are there differences in environmental pollution across the urban, suburban, and rural communities in which low-income children reside?
- Do differences in neighborhood pollution help explain differences in children's functioning across urbanicity?

Data

- Early Childhood Longitudinal Study – Kindergarten Class of 1998-1999 (ECLS-K)
  - Nationally representative cohort of 22,000 children entering kindergarten in 1998
  - Multi-method data collection following children through 8th grade
  - Oversampled low-income children and families
  - Sampled families across the urban-rural continuum
  - Analyses includes the ≈5,400 low-income children (less than 200% of the FPL) in sample through 3rd grade
    - Fall kindergarten (1998)
    - Spring 1st grade (2000)
    - Spring 3rd grade (2002)

Data


ECLS-K analysis sample by urbanicity
16%
17%
30%
36%
Large Urban Cities
Small Urban Cities
Suburbs
Rural Areas

Data

- Toxic Release Inventory (TRI)
  - TRI tracks the management of 650 toxic chemicals
  - U.S. facilities report annually on amount of chemicals released into the environment
  - Address of facilities included in data
  - TRI-CHIP provides “developmental” filter
- National-Scale Air Toxic Assessments (NATA)
  - Periodic, comprehensive evaluations of air toxics in the U.S.
  - NATA uses general information about emission sources to develop estimates of cancer, neurological, and respiratory risks
  - 2002 and 2005 results available for all U.S. Census Tracts

Measures: Child Development

- Measured at 3rd grade
  - Achievement
    - Direct cognitive assessments created for ECLS-K
      - Reading (α=.94) – letter/sound recognition to evaluating text
      - Math (α=.95) – identifying numbers/shapes/size to fractions, area, and volume
  - Behavioral functioning
    - Teacher reports of children's behaviors using Social Rating Scale
      - Internalizing (α=.95) – e.g. sad, lonely
      - Externalizing/Approaches to Learning/Self-Control (α=.89-.91) – e.g. talks out of turn, unable to focus

Measures: Child Development

- Child Health
  - Parent reports of child's general health and specific health/developmental problems
    - Fair/poor general health indicator
    - Asthma diagnosis indicator
    - Developmental delay diagnosis indicator

Measures: Urbanicity

- ECLS-K contains children's home census tracts and zip codes at 3rd grade
- Rural Urban Commuting Area codes used to classify children as living in:
  - Large urban cities – incorporated place within urbanized area of 750,000+ residents
  - Small urban cities – incorporated place within urbanized area of under 750,000 residents
  - Suburbs – places within an urbanized area, but not in central city core
  - Rural areas – non-metropolitan areas

Measures: Pollution

- Toxic releases (TRI data)
  - All chemicals and chemicals identified with developmental filter
  - On-site releases
  - 1998, 2000, and 2002 data used based on periodicity of ECLS-K
- Air quality (NATA data)
  - 2002 census tract-level modeled ambient risks
  - Total risk
  - Respiratory risk data (43 chemicals) and neurological risk data (23 chemicals)

Measures: Pollution

- Geographic Information Systems software (GIS) used to aggregate pollution at 1-, 2-, 5-, and 7-mile radii from the centroid of U.S. census tracts/zip codes
- Aggregate measures linked to children via their home census tract/zip code using the year closest to date of ECLS-K data collection
- Measures created that averaged neighborhood pollution across all waves of data (K – 3rd grade)

Measures

- Control variables (3rd grade)
  - Family income (continuous)
  - Race/ethnicity
  - Gender
  - Highest level of parental education
  - Reside in a home with married parents
  - Maternal employment
  - Number of children in home
  - Region of U.S. (Northeast, Midwest, South, or West)

Analytic Plan

- Question 1: Are there differences in low-income children's functioning across urbanicity
  - Multivariate regression/logistic regression models predicting child outcomes with urbanicity, controlling for covariates

$$\text{Child Outcome}_i = B_0 + B_1\text{Urbanicity}_i + B_2\text{Covariates} + \varepsilon_t$$

  - Post hoc tests to determine differences between urbanicity groups

Analytic Plan

- Question 2: Are there differences in environmental pollution across the urban, suburban, and rural communities in which low-income children reside?
  - Multivariate regression/logistic regression models predicting pollution with urbanicity, controlling for covariates

$$Pollution_i = B_0 + B_1 Urbanicity_i + B_2 Covariates + \varepsilon_t$$

  - Post hoc tests to determine differences between urbanicity groups

Analytic Plan

- Question 3: Could differences in neighborhood pollution across urbanicity help explain urbanicity-related differences in functioning?
  - Multivariate regression/logistic regression models predicting child outcomes with urbanicity and pollution, controlling for covariates

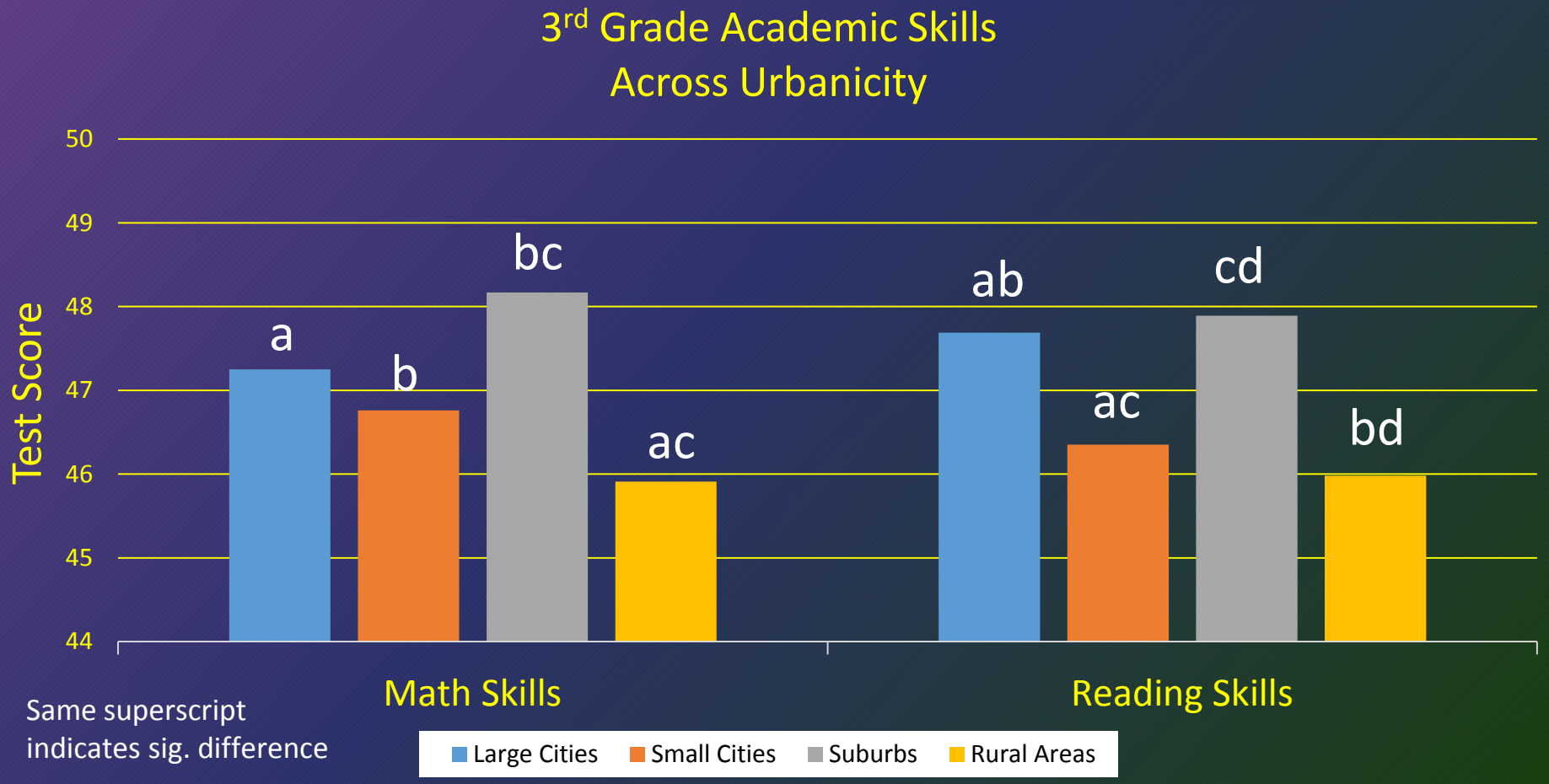
$$\text{Child Outcome}_i = B_0 + B_1\text{Urbanicity}_i + B_2\text{Pollution} + B_3\text{Covariates} + \varepsilon_t$$

  - Examine how the inclusion of pollution measures diminishes/exacerbates urbanicity gaps in child outcomes

Question 1

Are there differences in low-income children's functioning related to urbanicity?

Results: Achievement



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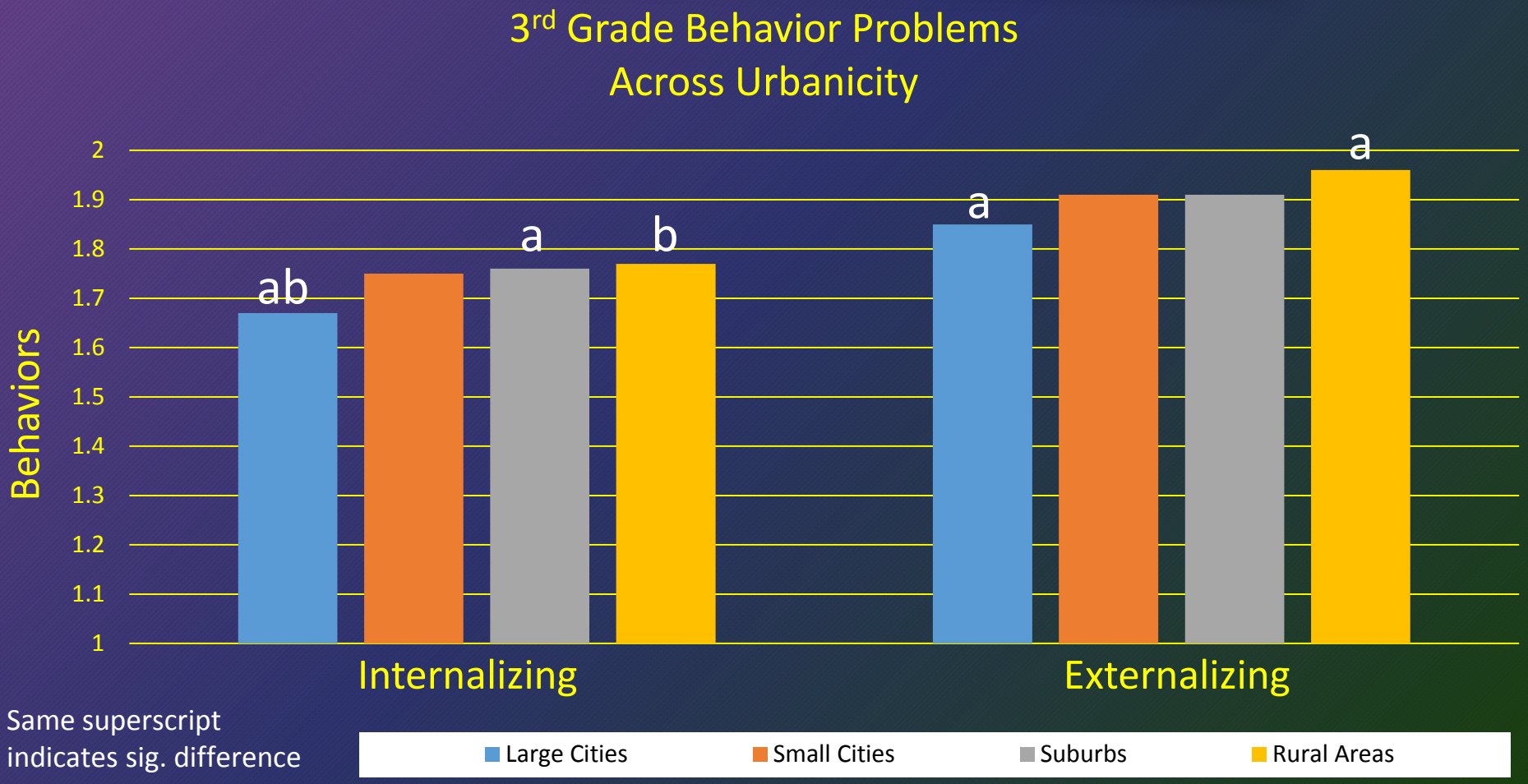
Results: Behavior



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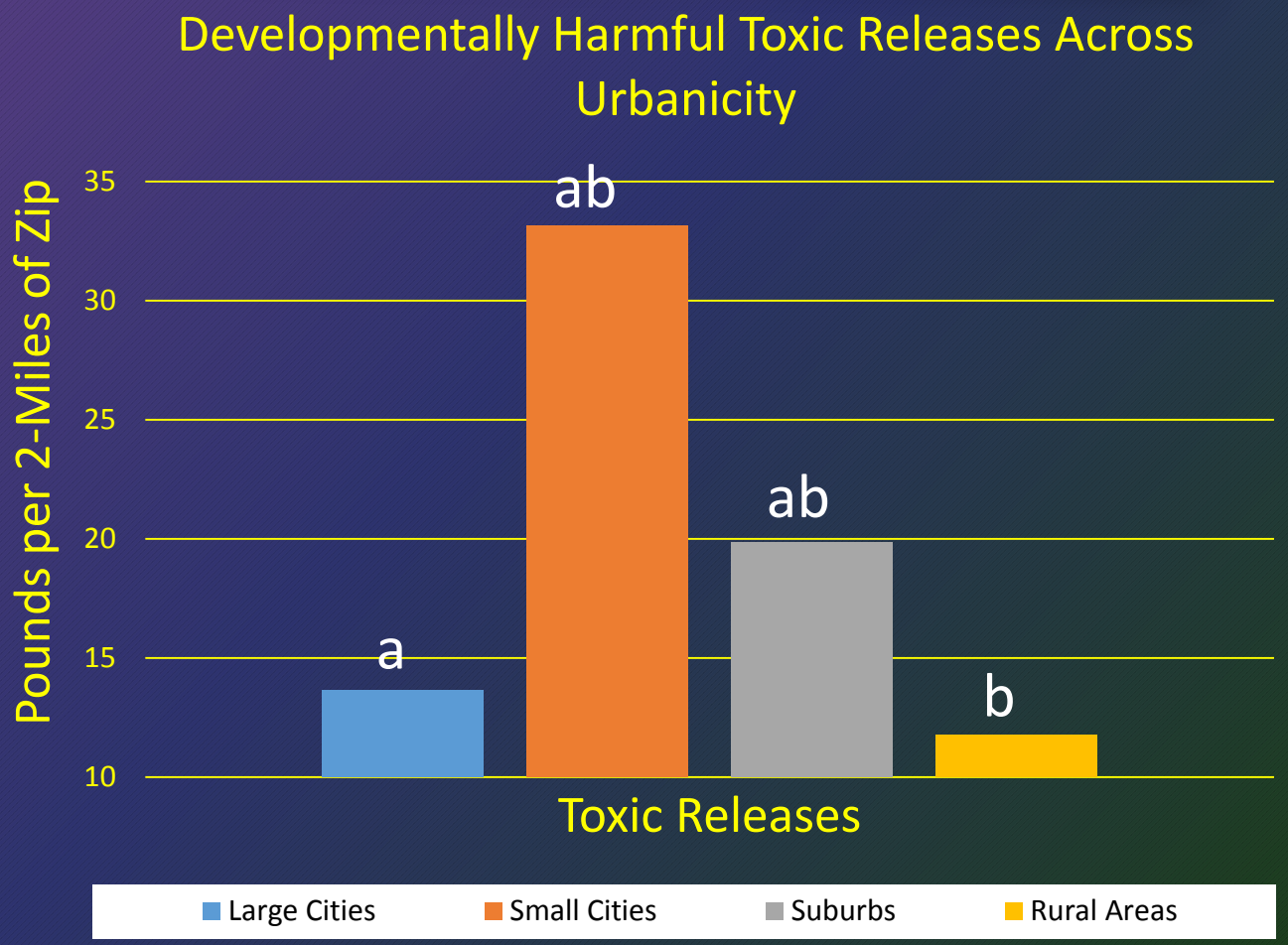
Results: Health

- No urbanicity-related differences in health outcomes

Question 2

Are there differences in environmental pollution across the urban, suburban, and rural communities in which low-income children reside?

Results: Toxic Releases



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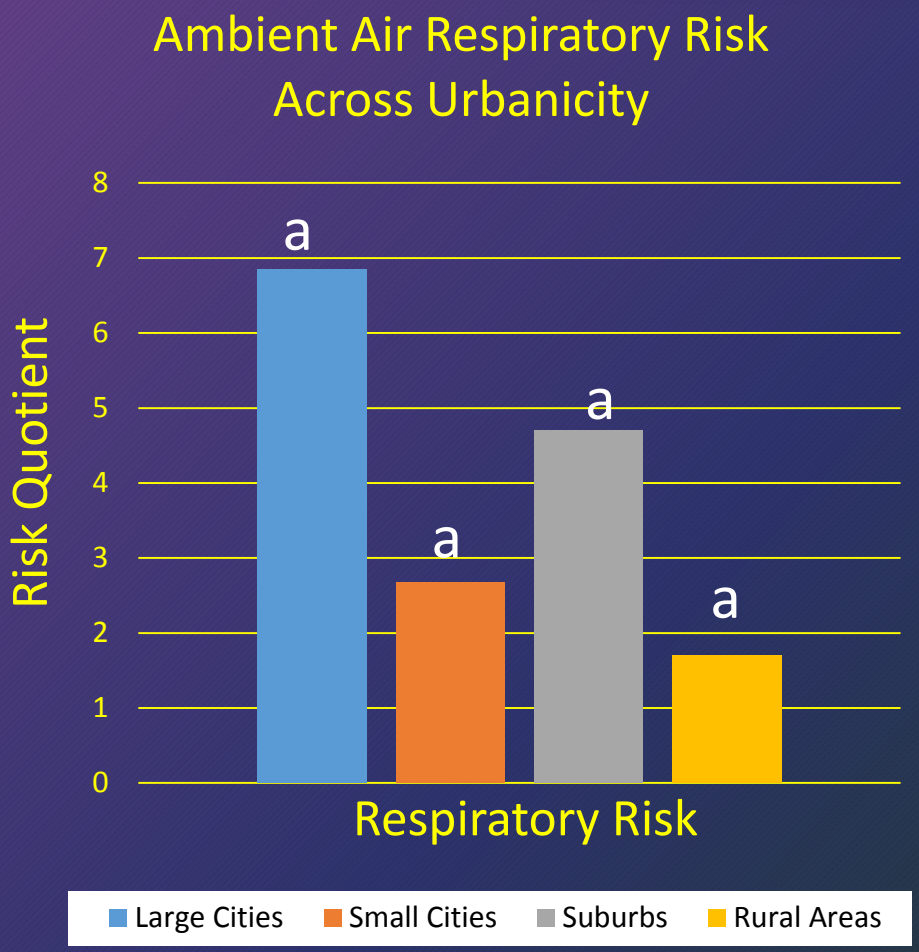
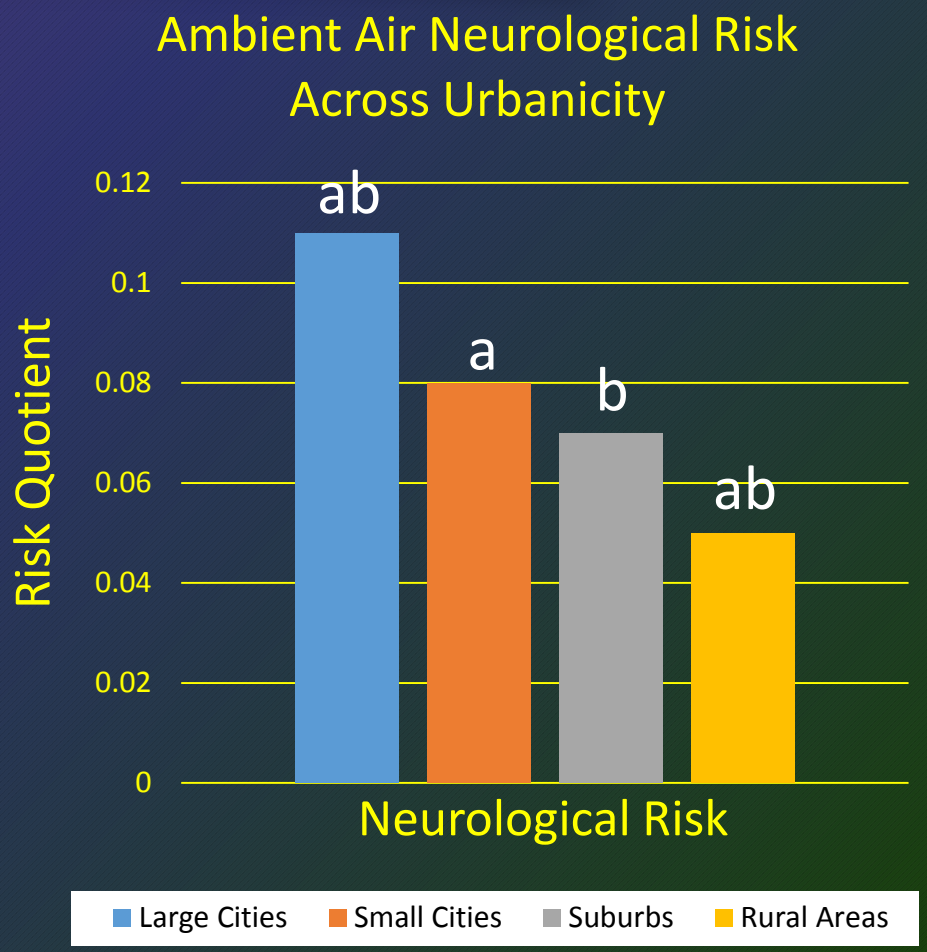
Results: Air Quality





Question 3

Could differences in neighborhood pollution across urbanicity help explain urbanicity-related differences in functioning?

Results: Pollution Measures

1. Developmental subset of chemicals have better predictive validity than total TRI chemicals

2. For toxic release measure, 2- or 5-mile radius most predictive of child functioning

3. Cumulative measures predict development better than contemporaneous measures . . . but only if longitudinal pollution measures are available

Results: Pollution Measures

- Increased toxic releases within 2 miles of children's homes predicts lower math skills
  - Increase of 100 lbs. of toxics released in the neighborhood predicts .05 of a SD decrease in math scores
- Increased toxic releases within 5 miles of children's homes predicts higher internalizing behaviors
  - Increase of 100 lbs. of toxics released in the neighborhood predicts .03 of a SD decrease in internalizing scores

Results: Pollution Measures

- Higher respiratory risk due to poor air quality within 1 mile of children's homes predicts worse child general health
  - A 1 SD increase in respiratory risk is linked to a 26% increase in odds of parent reporting child is in fair/poor health
- Higher respiratory risk due to poor air quality within 1 mile of children's homes predicts increased rates of asthma diagnoses
  - A 1 SD increase in respiratory risk is linked to a 19% increase in odds of an asthma diagnosis

Initial Results: Mediation

- After accounting for ambient air respiratory risk, low-income rural children are more likely to be diagnosed with asthma than low-income children living in suburbs

Summary

- Low-income rural children look worse than low-income children living in large cities and suburbs on several developmental outcomes
- But low-income rural children experience lower levels of environmental pollution in their neighborhoods
- Other community factors may explain disparities

Discussion

- Measures of environmental pollution are useful in analyzing child development, but much room for improvement
- Limiting measures of pollution to toxics that are particularly harmful to development may be beneficial
- More research is needed to determine relevant “neighborhood” for the purpose of environmental risk
- Importance of developing more frequent measures of environmental risk

Future Directions

- Create more refined measures of environmental pollution in children's communities
- Study links between environmental pollution and development during early childhood
- Undertake studies that utilize methods for causal inference

Acknowledgements

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