

# Cancer Risk from Air Toxics in the St. Louis Metropolitan Area

Christine C. Ekenga, PhD, MPH  
Assistant Professor of Public Health  
[ekengac@wustl.edu](mailto:ekengac@wustl.edu)

Collaborative on Health and the Environment  
July 22, 2020

---

# Outline

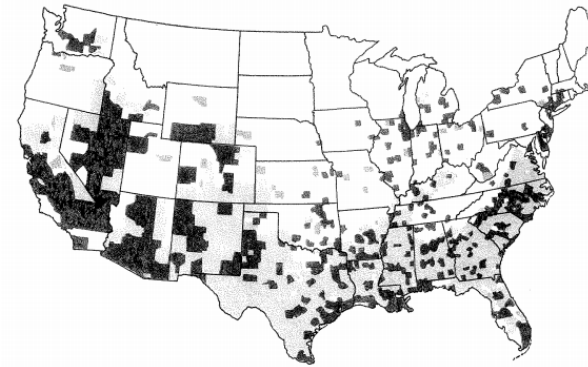
- Background
    - Environmental Justice in the US
    - Environmental and Cancer Concerns in the St. Louis Metropolitan Area
  - Cancer Risk from Air Toxics: A Spatial Analysis of the St. Louis Metropolitan Area
  - Next Steps
-

# Environmental Justice in the United States

- Warren County, NC PCB Landfill (1982)
- U.S. General Accounting Office Study (1983)
- Toxic Waste in the United States (1987)
  - United Church of Christ Commission (UCC) on Racial Justice
- First National People of Color Environmental Leadership Summit (1991)
  - 17 Principles of Environmental Justice
- Executive Order 12898 (1994)
  - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

## TOXIC WASTES AND RACE In The United States

A National Report on the Racial and Socio-Economic  
Characteristics of Communities  
with Hazardous Waste Sites

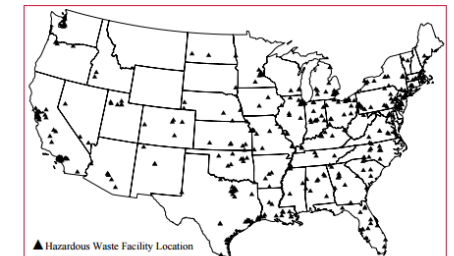


COMMISSION FOR RACIAL JUSTICE  
United Church of Christ  
©1987



## Toxic Wastes and Race at Twenty 1987—2007

A Report Prepared for the  
United Church of Christ  
Justice & Witness Ministries



WE, THE PEOPLE OF COLOR, gathered together at this multinational People of Color Environmental Leadership Summit, to begin to build a national and international movement of all peoples of color to fight the destruction and taking of our lands and communities, do hereby re-establish our spiritual interdependence to the sacredness of our Mother Earth; to respect and celebrate each of our cultures, languages and beliefs about the natural world and our roles in healing ourselves; to ensure environmental justice; to promote economic alternatives which would contribute to the development of environmentally safe livelihoods; and, to secure our political, economic and cultural liberation that has been denied for over 500 years of colonization and oppression, resulting in the poisoning of our communities and land and the genocide of our peoples, do affirm and adopt these Principles of Environmental Justice:

## Environmental Justice

... is the **fair treatment** and **meaningful involvement** of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.



## Fair Treatment

No group of people should bear a **disproportionate share** of the **negative environmental consequences** resulting from industrial, governmental and commercial operations or policies.



## Meaningful Involvement

- People have an opportunity to **participate** in decisions about activities that may affect their environment and/or health;
- The public contribution can **influence** the regulatory agency's decision;
- Their concerns will be **considered** in the decision making process; and
- The decision makers **seek out** and **facilitate** the involvement of those potentially affected.



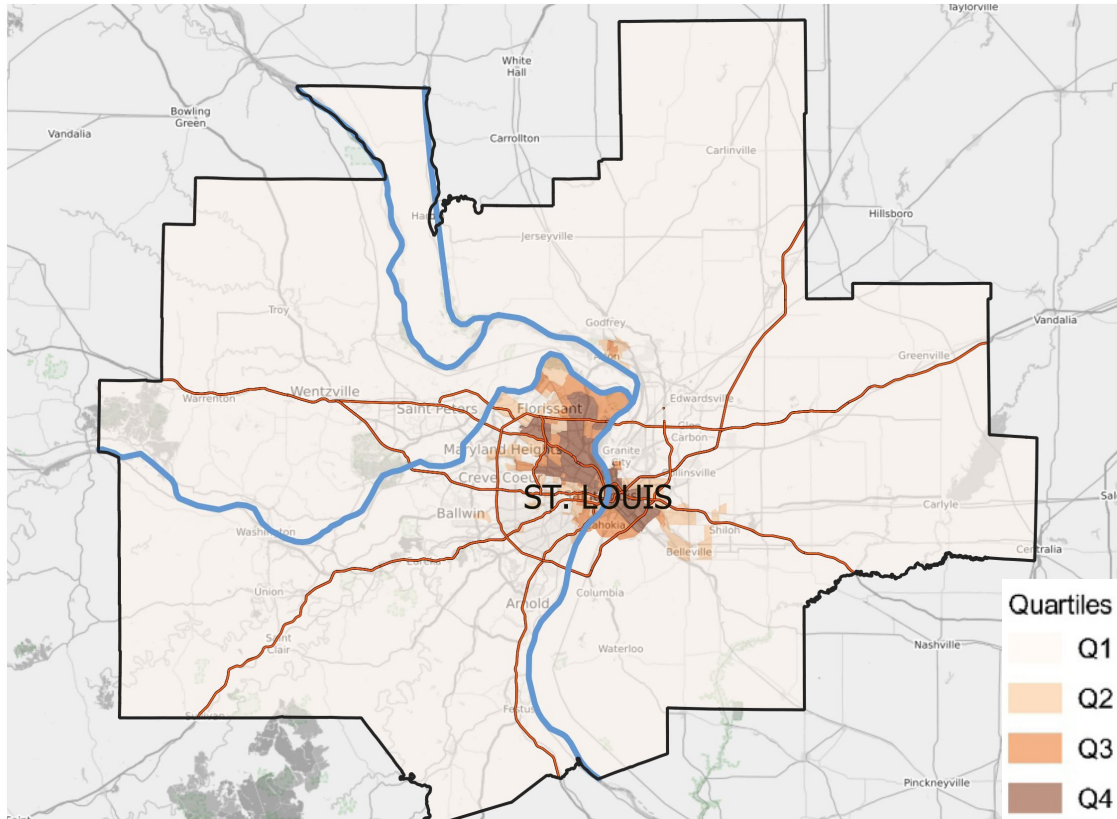
## St. Louis, MO-IL Metropolitan Area (MSA)

- 15-county region that spans Missouri and Illinois
- 2.8 million residents
  - 75% reside in Missouri
    - 76% White, 18% African American, 3% Asian
    - 3% Hispanic
  - 13% <High School education
  - 40% Household income <\$50,000
  - 14% Below poverty

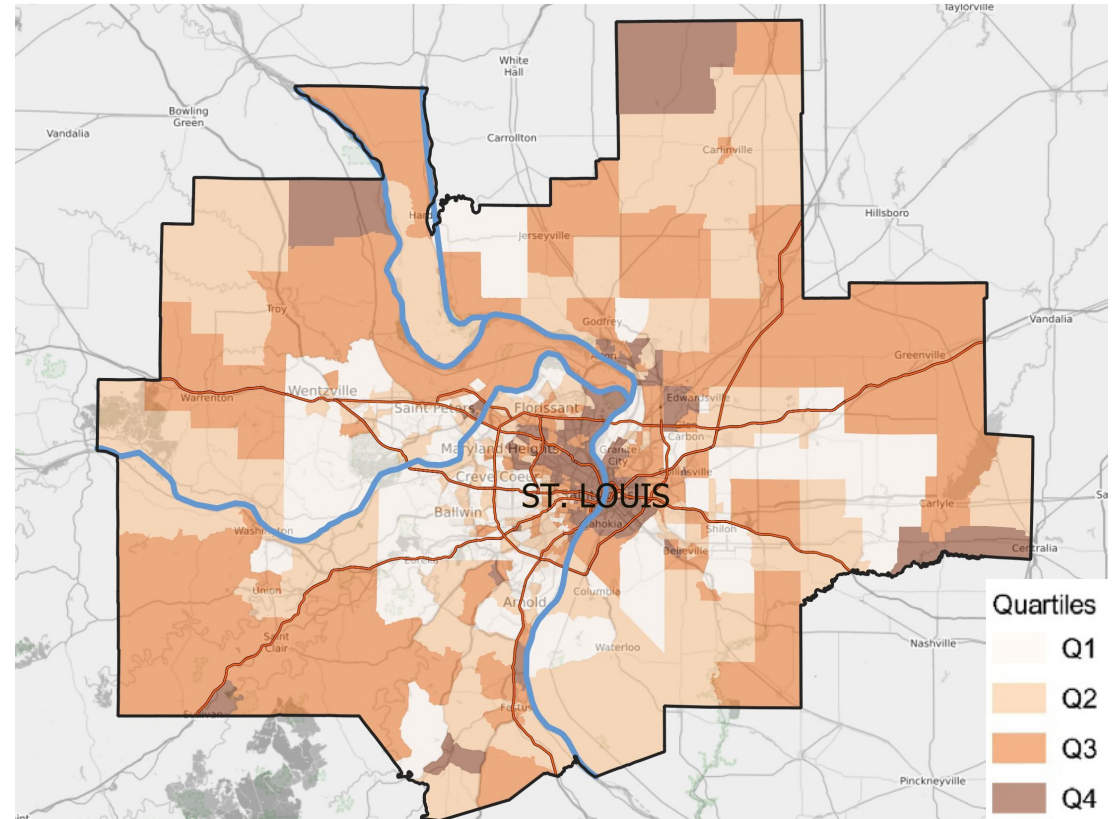


# St. Louis Metropolitan Area

## Non-White



## Poverty





# Environmental and Cancer Concerns in the St. Louis Metro Area

## Cancer

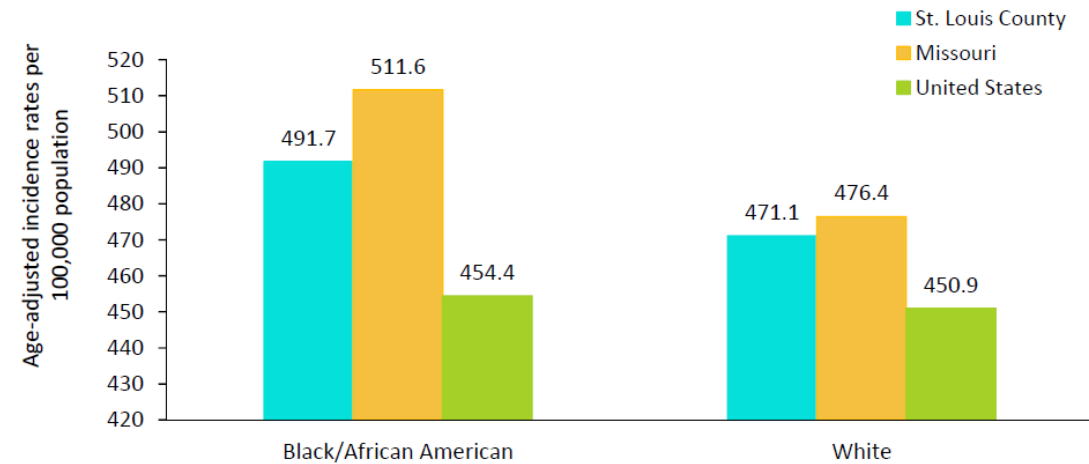
- Long-standing community concerns
- Racial disparities
  - African American residents had high rates for both incidence and mortality of all-cause cancers compared to white residents.

## Environment

- Air quality, Flooding, Neighborhood Safety
  - “...race shape both the realities of environmental threats as well as residents’ perceptions about environmental injustice in their communities”

Kang J., Fabbre VD. and Ekenga CC., 2019. “Journal of Community Practice, 27(3-4), pp.317-333.

New cases of cancer by race, St. Louis County, Missouri, and United States, 2011–2015



Cancer Profile – St. Louis County, Missouri 2019  
St. Louis County Department of Public Health

# Exposure to Carcinogenic Air Toxics in the St. Louis Metro Area

## National Air Toxics Assessment

- Characterization of air toxics across the nation
- 140 hazardous air pollutants with health benchmarks at census tract level
- Emission sources: Point, Non-point, On-road mobile, Non-road mobile, Fire, Secondary, Biogenics, and Background
- **Cancer risk estimates assume chronic exposure for 70 years**

Inform efforts to identify and prioritize air toxic pollutants, source types, and locations of potential concern

# Exposure to Carcinogenic Air Toxics in the St. Louis Metro Area

## Study Aim

Examine relationships between neighborhood characteristics and exposure to carcinogenic air toxics in the St. Louis MSA

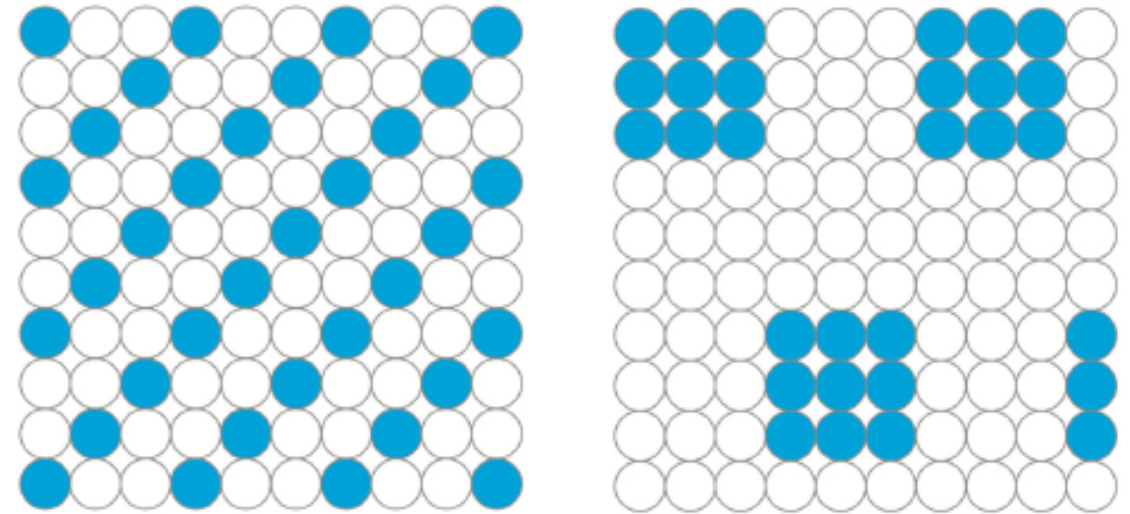
- 615 Census tracts
- Density
  - Race/ethnicity
  - Income
  - Employment
  - Education
  - Housing
- Segregation
  - Black Isolation
  - Poverty Isolation



# Assessing Residential Segregation

## Modifiable areal unit problem

- Failure to recognize the important variations of segregation levels across local areas or neighborhoods
- Ethnic density (i.e., %AA) as a “proxy” cannot quantify how different population groups are distributed across space.
- Ethnic density  $\neq$  Residential segregation
- Local spatial segregation indices are ideal.



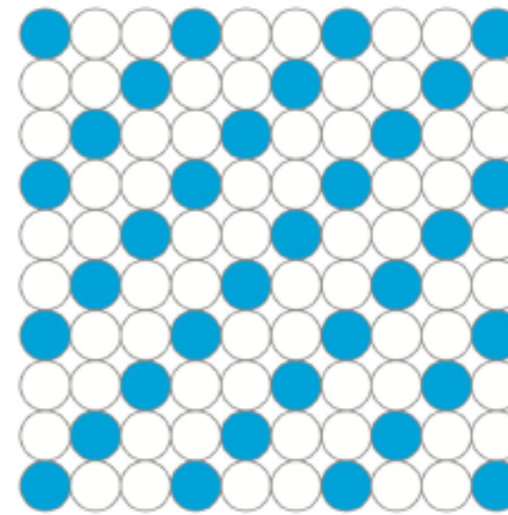
# Assessing Residential Segregation

## Isolation

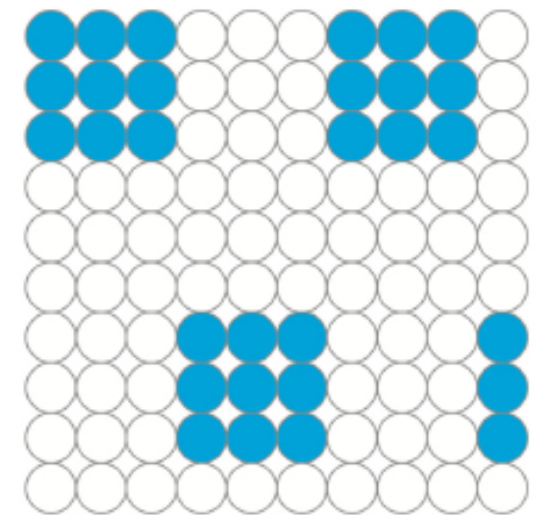
- Probability of interaction between members of the same versus different group
  - Index ranges from 0 (complete integration) to 1 (complete segregation)
  - Black Isolation
  - Poverty Isolation

$$\text{Black isolation} = \frac{cb_i}{B} \times \frac{cb_i}{ct_i}$$

where  $cb_i$  is the composite population count of black population in census tract  $i$ ,  $B$  is the population count of black population for the entire study area (i.e., St. Louis metropolitan area), and  $ct_i$  is the composite population of the total population in census tract  $i$ .



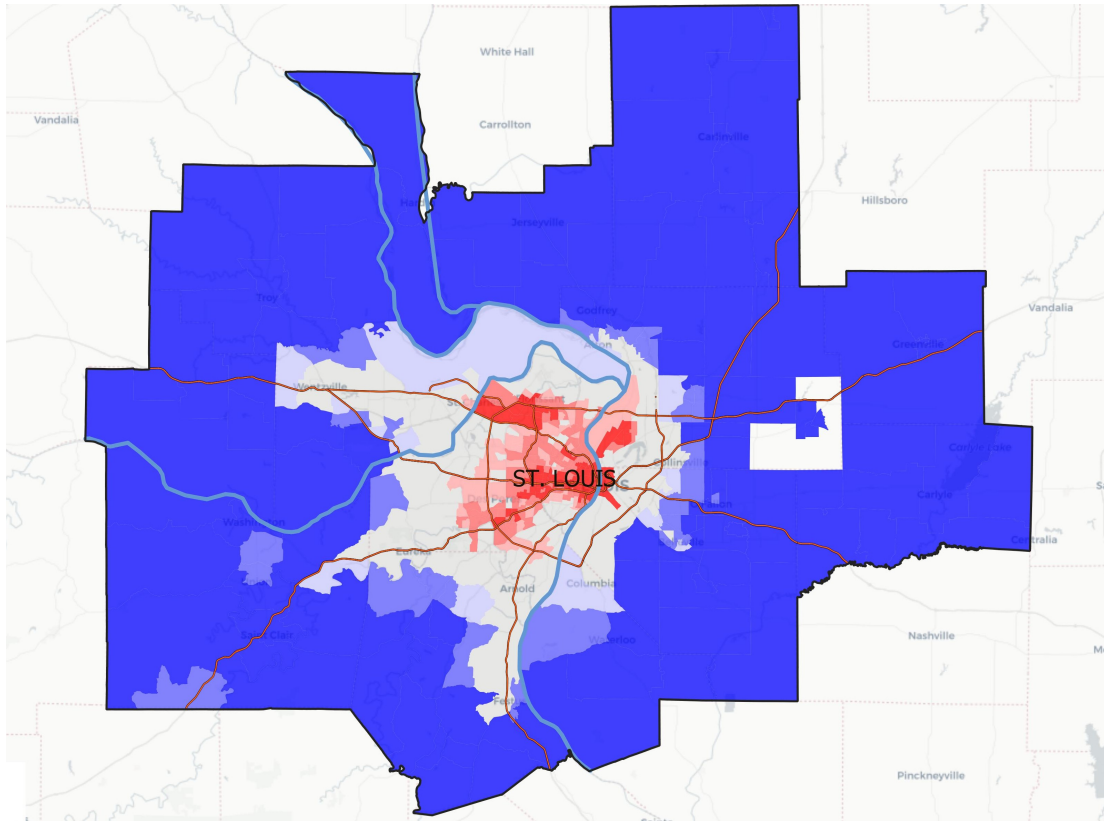
Integration



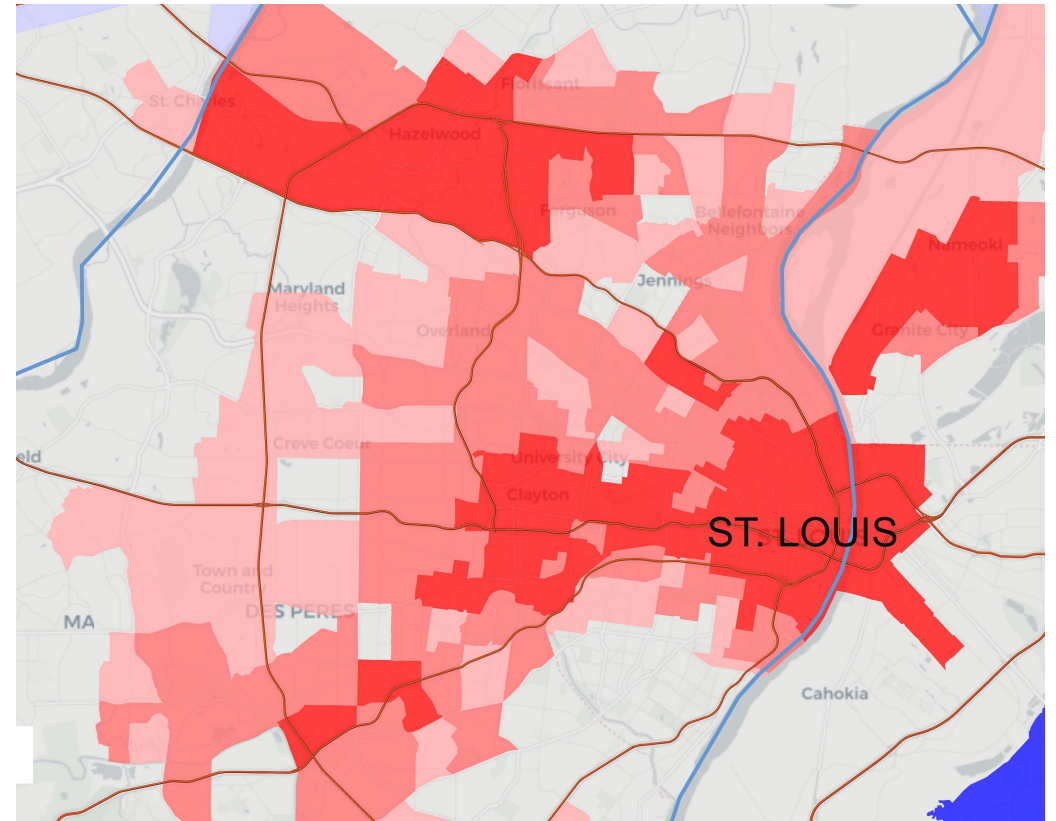
Segregation

# Carcinogenic Air Toxics in the St. Louis Metro Area

## St. Louis Metro Area



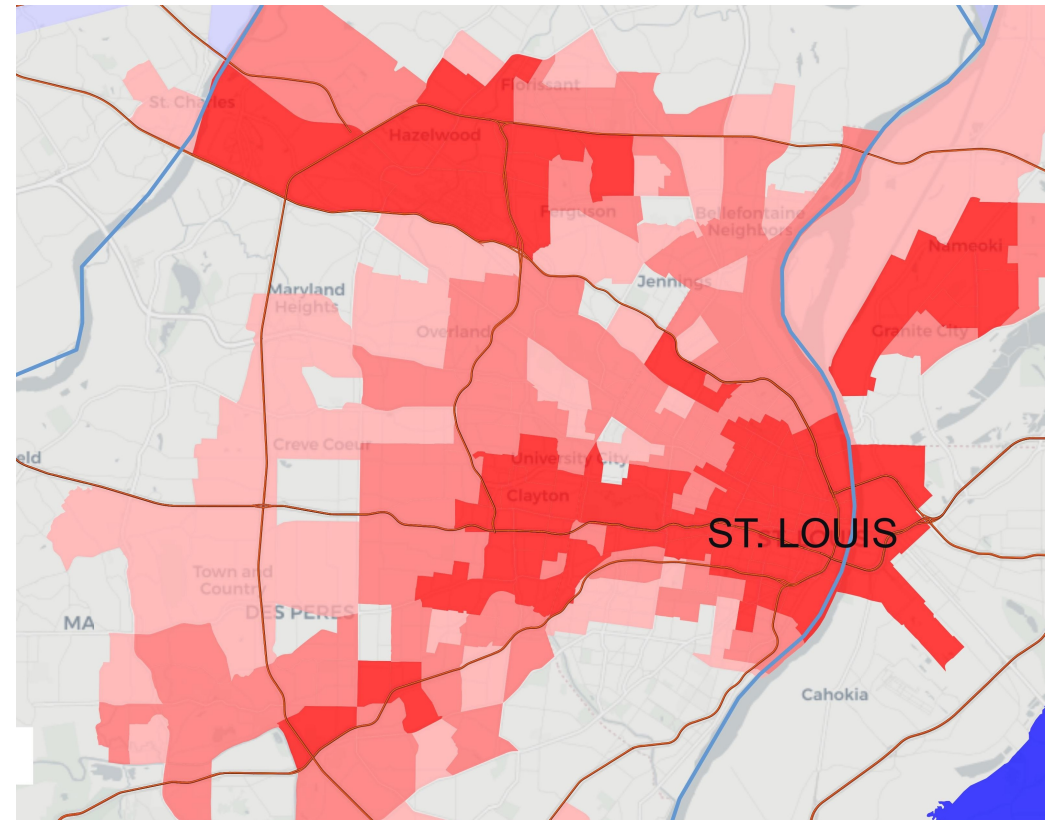
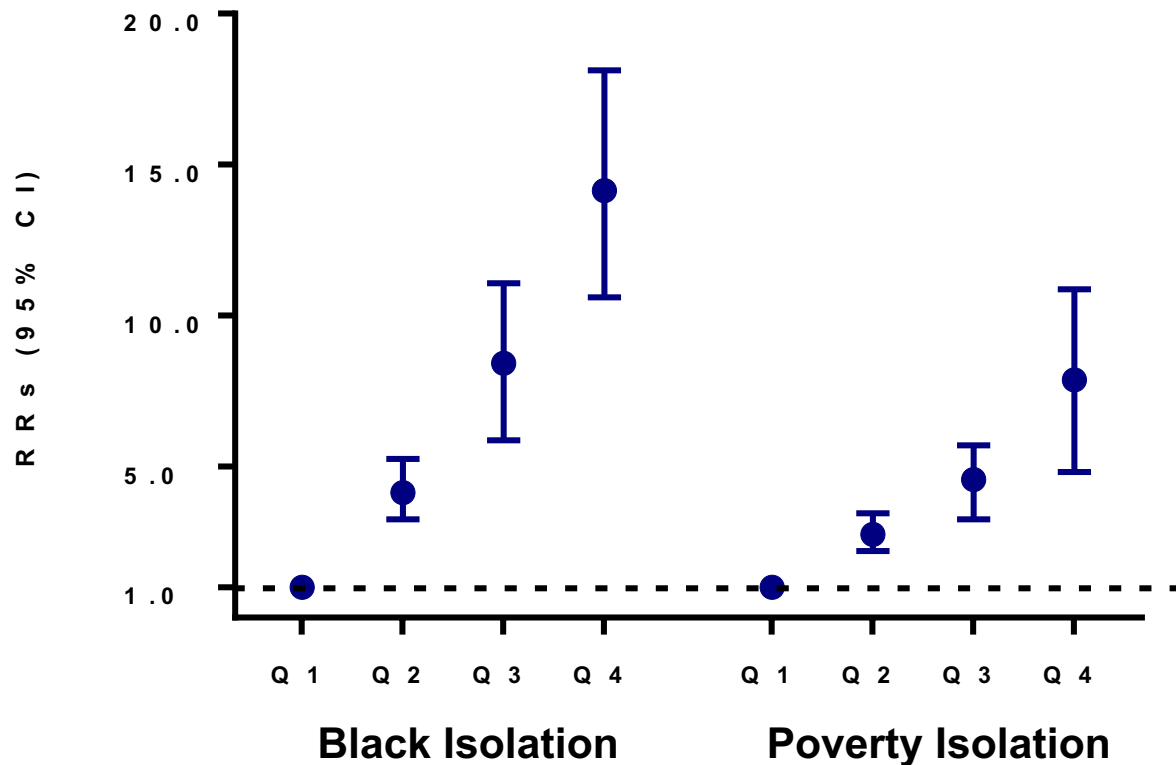
## Zoomed-In View



Red = Elevated cancer risk; Blue = Low cancer risk; Grey = NS

# Neighborhood Characteristics and Exposure to Carcinogenic Air Toxics in the St. Louis Metro Area

## Zoomed-In View



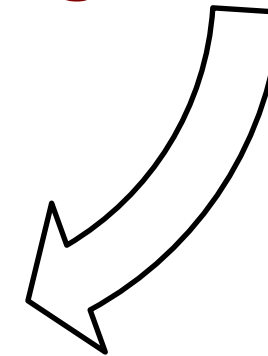
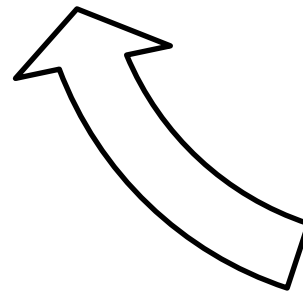
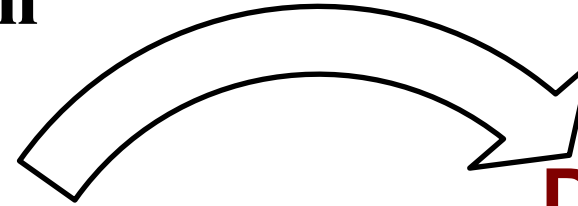
Red = Elevated cancer risk; Blue = Low cancer risk; Grey = NS

## Segregation and Air Pollution

**Disenfranchised  
community**

**Differential  
enforcement of  
environmental  
regulations**

**Decreased  
property  
values**

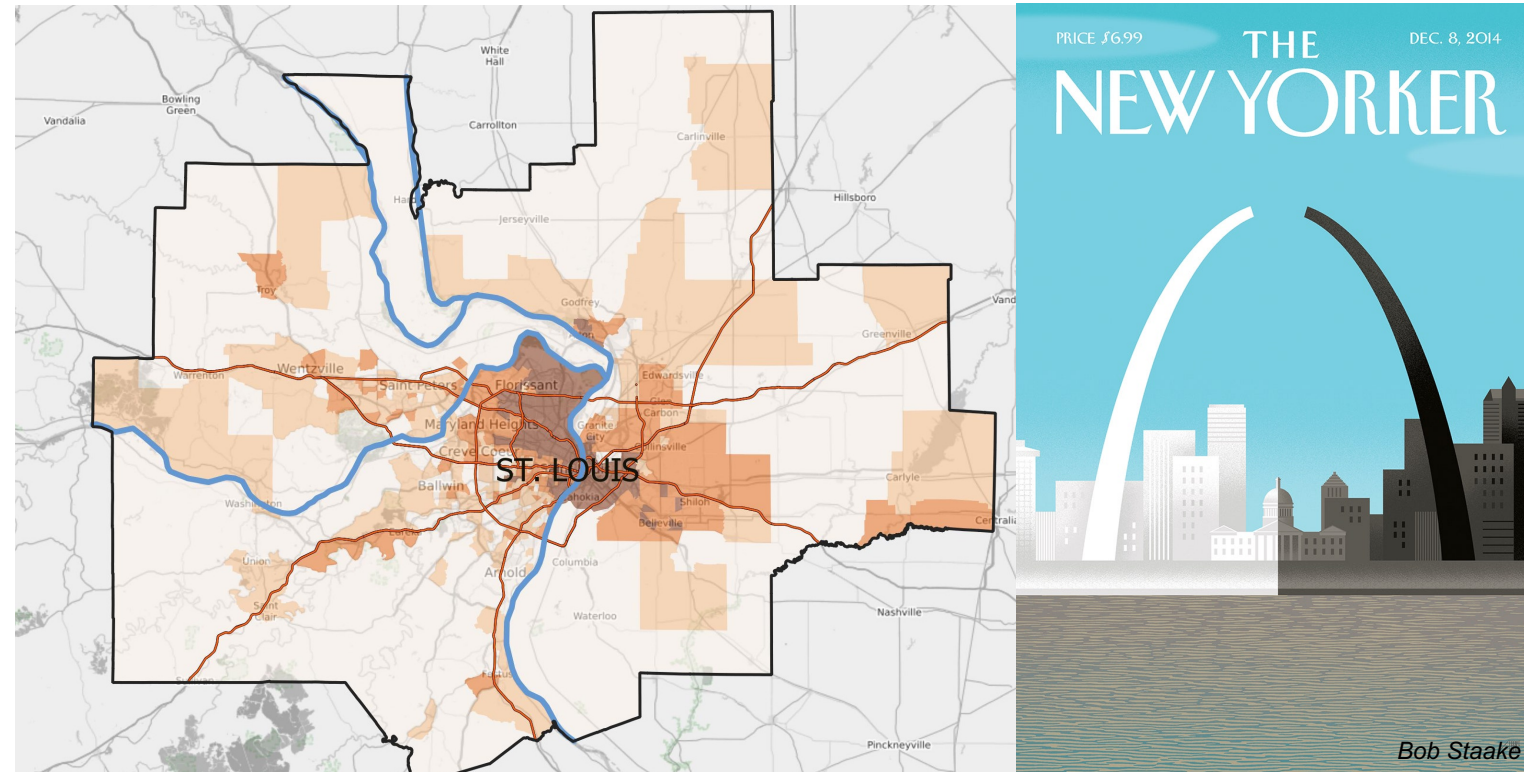




# Segregation in the St. Louis Metropolitan Area

- *Legal Segregation of Negroes in St. Louis (1913)*
- *Shelley v. Kremer (1948)*
  - Racial covenants
- *Davis et al. v. the St. Louis Housing Authority (1954)*
  - Public housing
- *Jones v. Alfred H. Mayer Co. (1968)*
  - Private property

## Black Isolation



## Conclusions and Next Steps

- Associations between neighborhood racial and socioeconomic characteristics and exposure to carcinogenic air toxics
  - Consistent with prior studies
  - On-road mobile sources
- Policy and Future Research
  - Air quality monitoring
  - Transportation
  - Housing
  - Other types of pollution
  - Community engagement



## Acknowledgements

- Masayoshi Oka
- Cheuk Yui Yeung
- Joonmo Kang
- Vanessa Fabbre
- Bill Winston
- Angela Hobson



NIH/NCI P30 CA091842  
CDC/NIOSH U19 OH008868

**Thank You!**

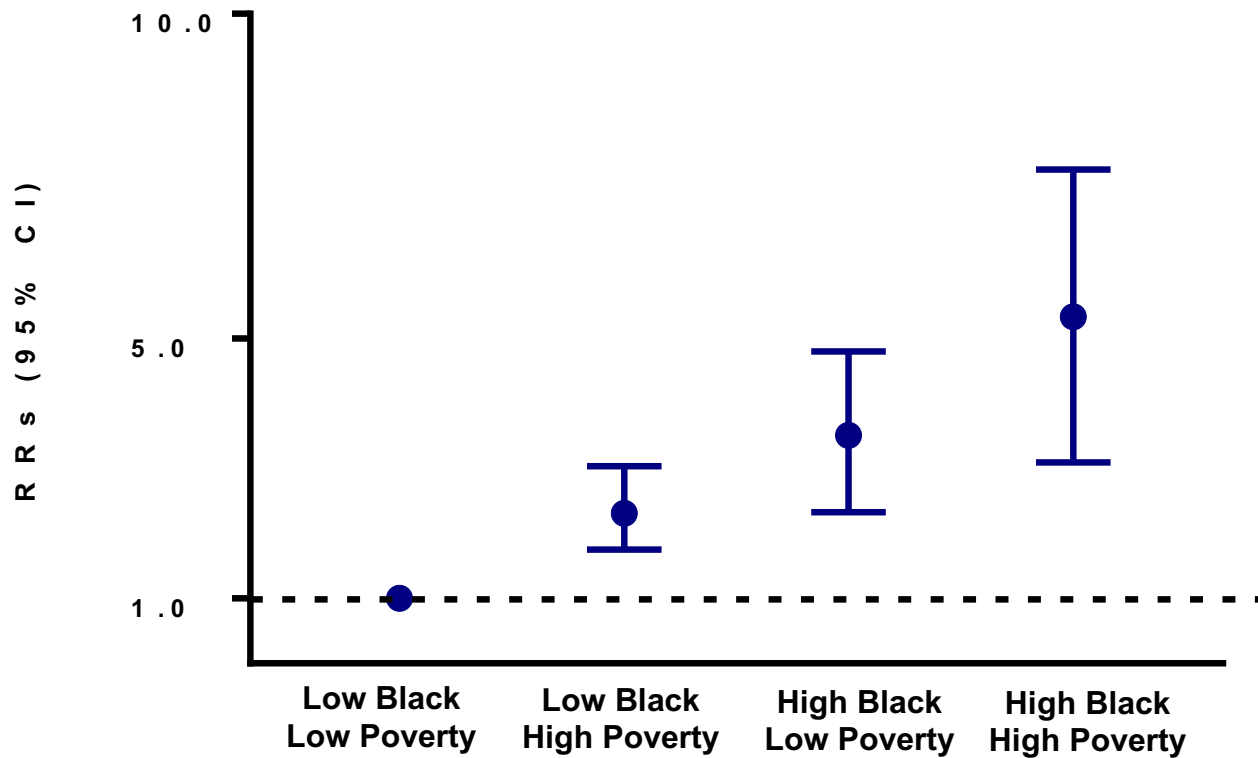
**Christine C. Ekenga, PhD, MPH**

ekengac@wustl.edu

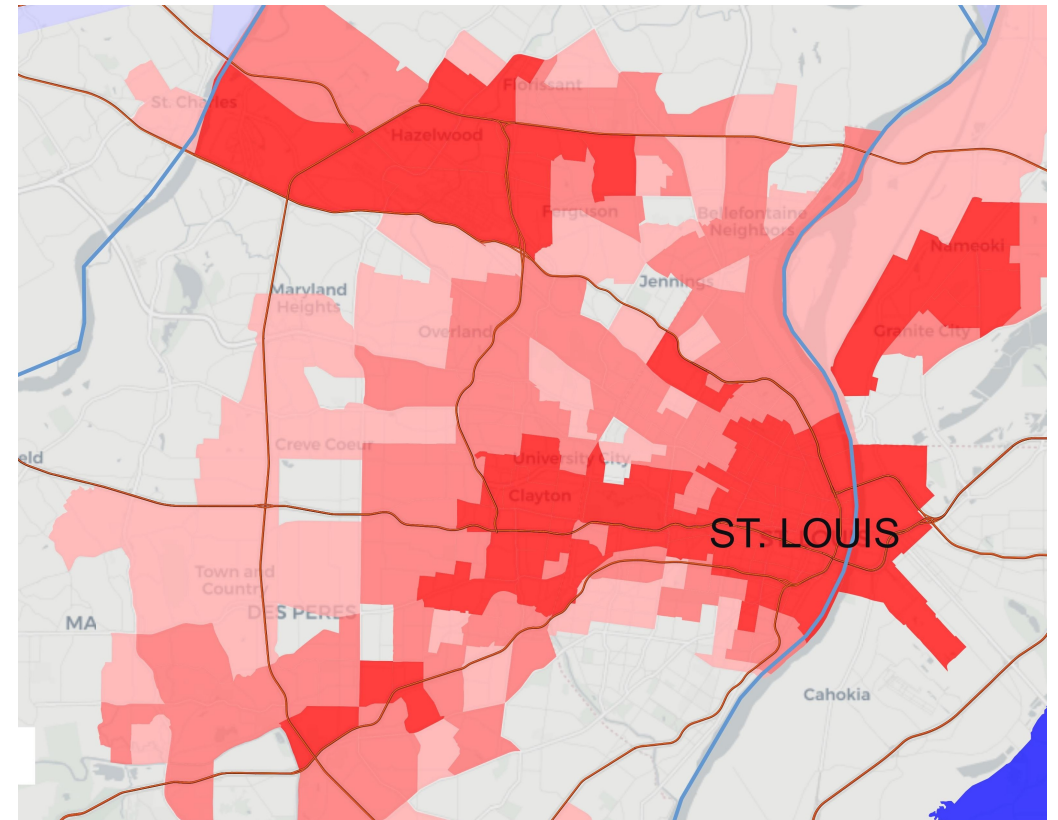
@DrEkenga

---

# Neighborhood Characteristics and Exposure to Carcinogenic Air Toxics in the St. Louis Metro Area



## Zoomed-In View



Red = Elevated cancer risk; Blue = Low cancer risk; Grey = NS