

Environmental inequality in the neighborhood networks of urban mobility in U.S. cities

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Research Framework

- Neighborhoods impact individual health and well-being
- Low-income and minority neighborhoods more disadvantaged
 - Helps explain racial and social inequalities
- Neighborhood disadvantage is spatially clustered
 - Extra-local setting

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 - Extra-local setting
- Neighborhoods that residents visit during the day

Research Framework

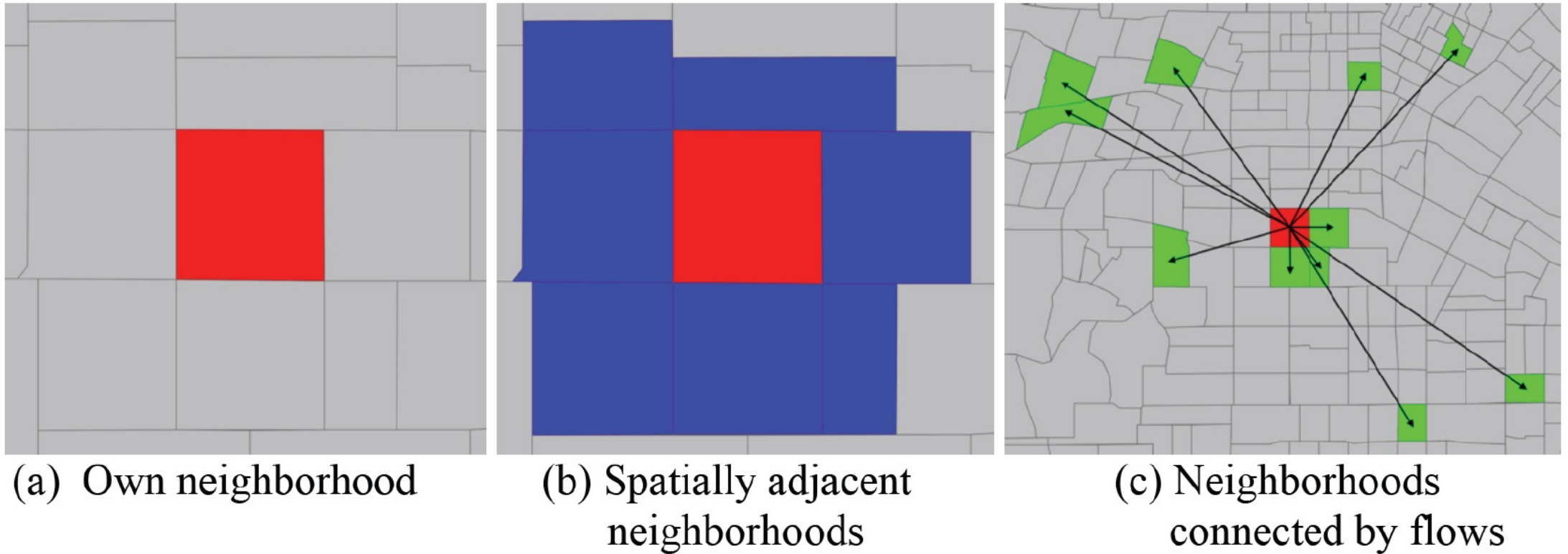


Figure 1: Three Ecological Layers of Neighborhood Structure

Research Framework

- Activity Spaces
 - Obligations, tasks, and social engagements may draw people out of, and potentially far from, their residential context (Browning and Soller, 2014; Cagney et al., 2020)
- Social network
 - Diffusion occurring through social ties, which may occur between actors spatially distant from one another (Graif et al., 2014)
- Urban mobility
 - Urban mobility connects communities both near and far (Wang et al., 2018; Candipan et al., 2021)

Research Question

What are the levels of exposure to air pollution levels for residents residing in Black, White, Hispanic, Asian, Poor and Non-poor neighborhoods?

- Residential neighborhood
- Adjacent neighborhoods
- Neighborhoods they travel to for work, school, errands and leisure

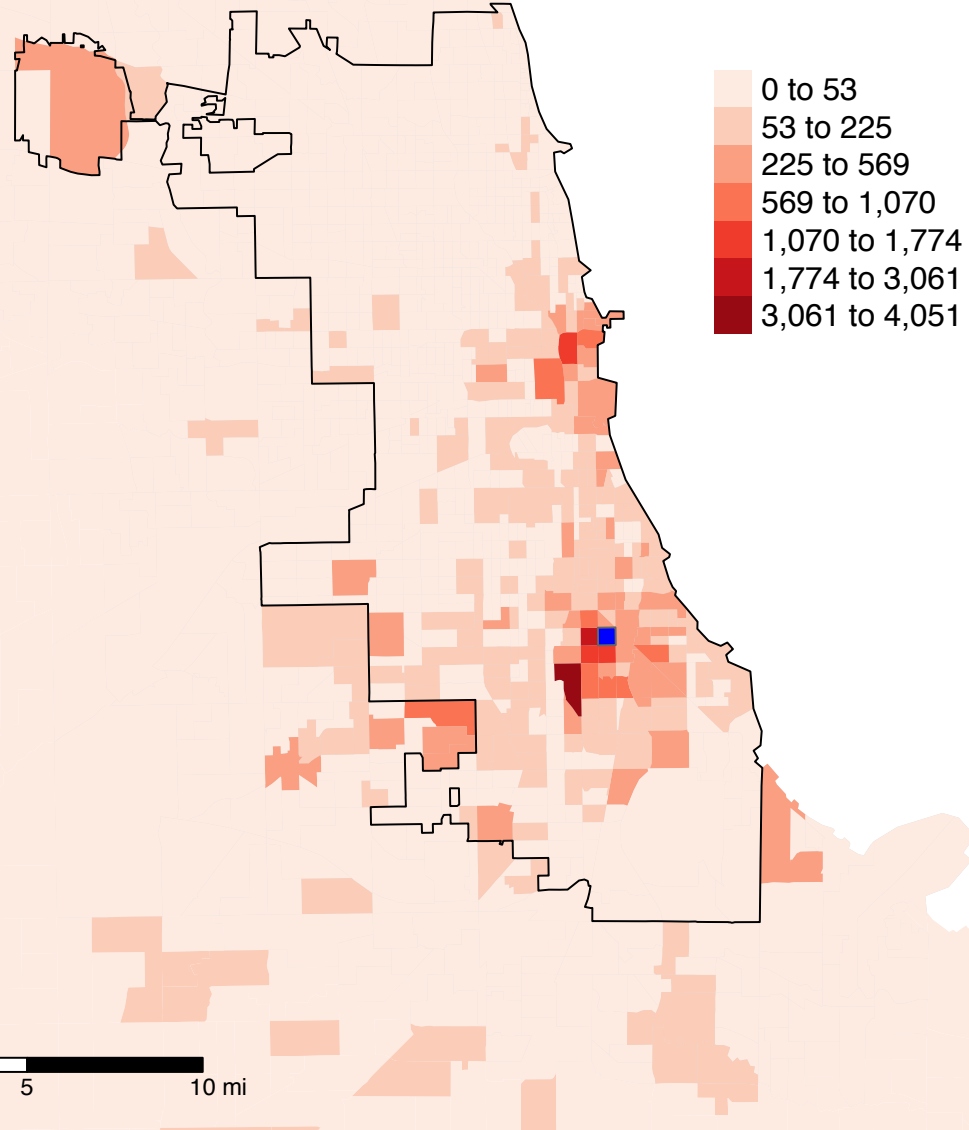
Research Design

- Anonymized cell phone location data for more than 40 million cell phones (Safegraph)
- Daily number of pings in a destination neighborhood and the home neighborhood location of the pings
 - Destination: Points of interests
 - Home: Cell phone detected most at night (18:00-7:00) over a six-week period

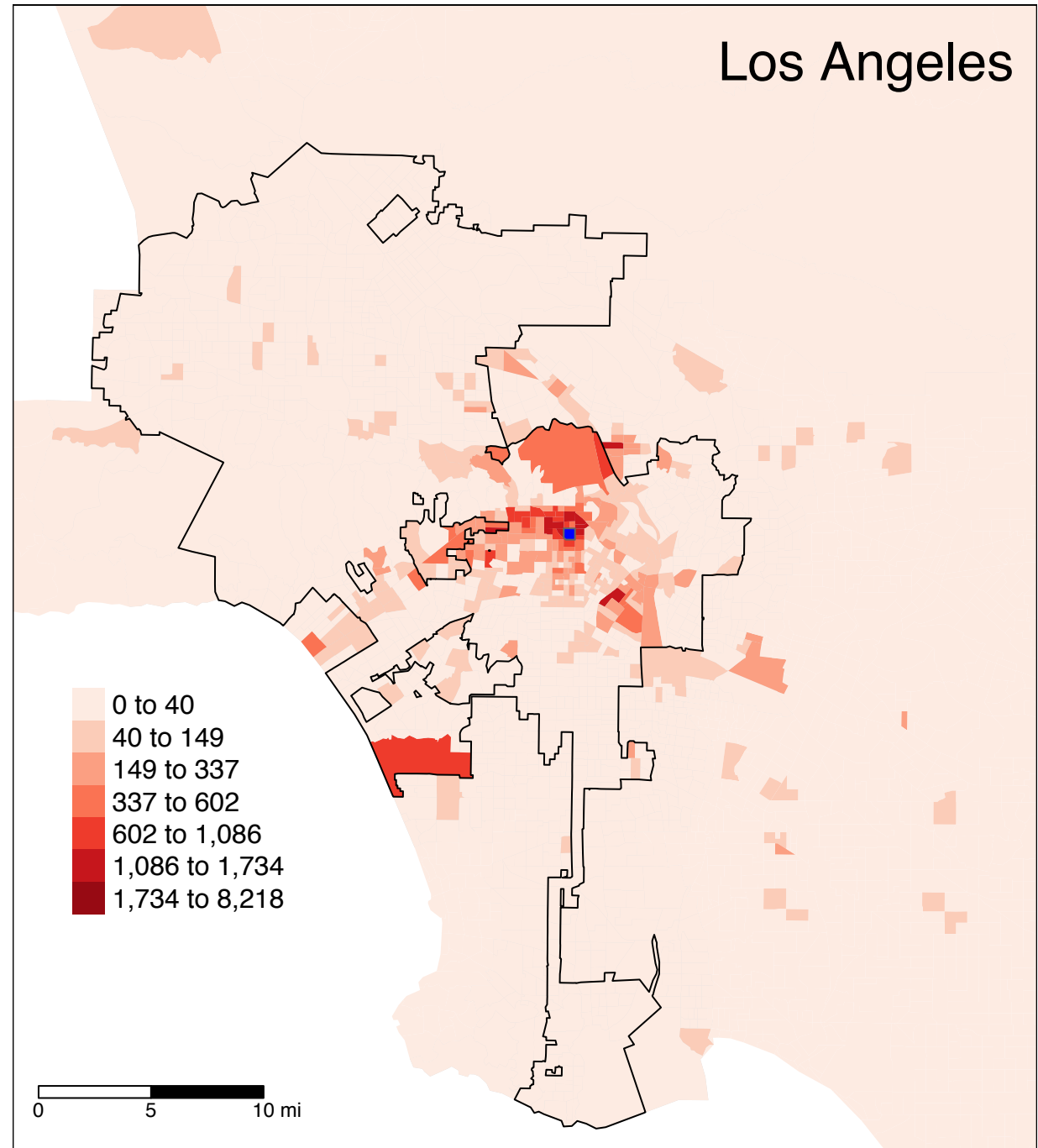
Research Design

- November 2018 to November 2019
- 88 of the most populous U.S. cities
- Travel patterns of residents from block groups in sample cities to block groups
 - Within city boundaries
 - Across all neighborhoods within the metropolitan area
- Aggregated up to tract level

Chicago



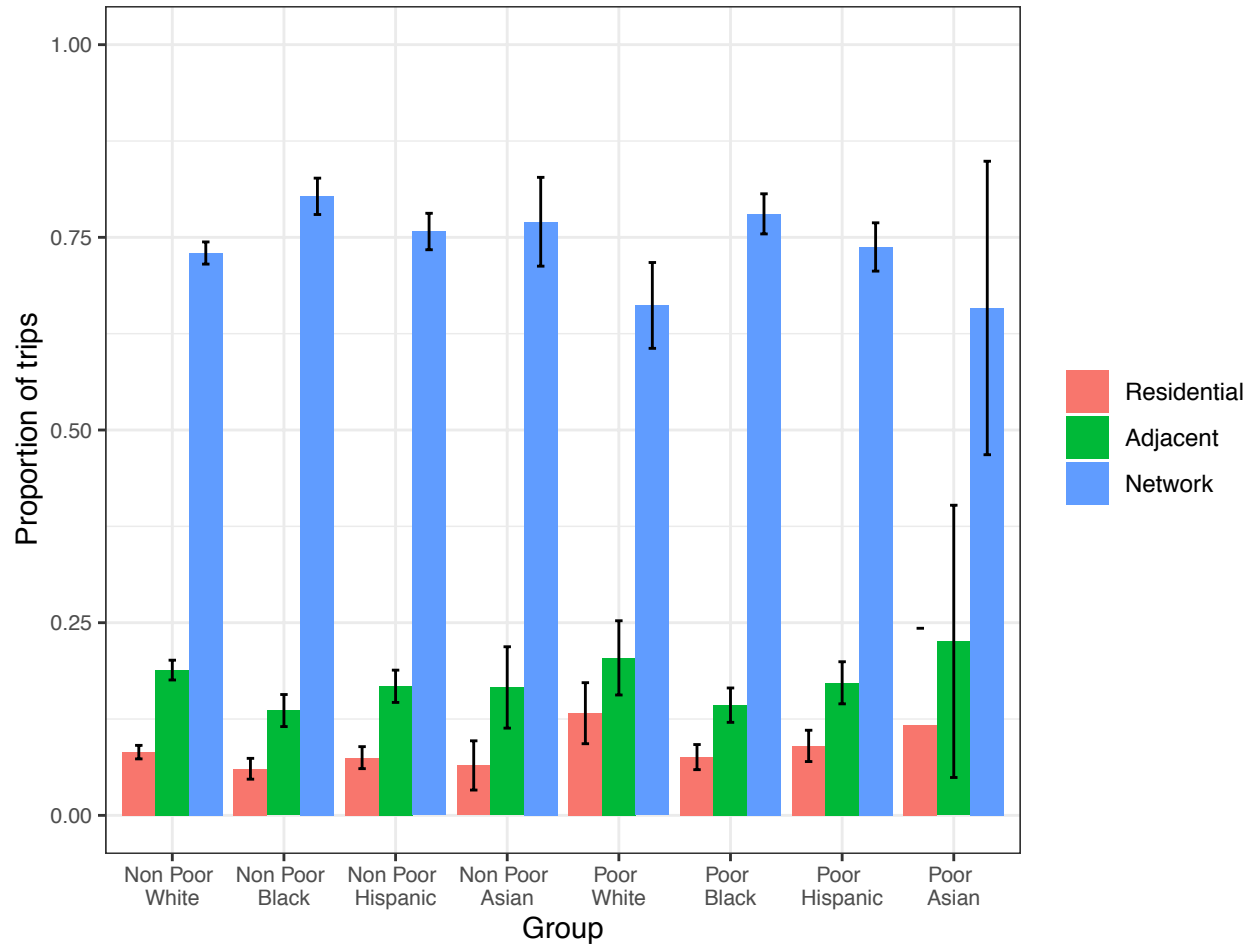
Los Angeles



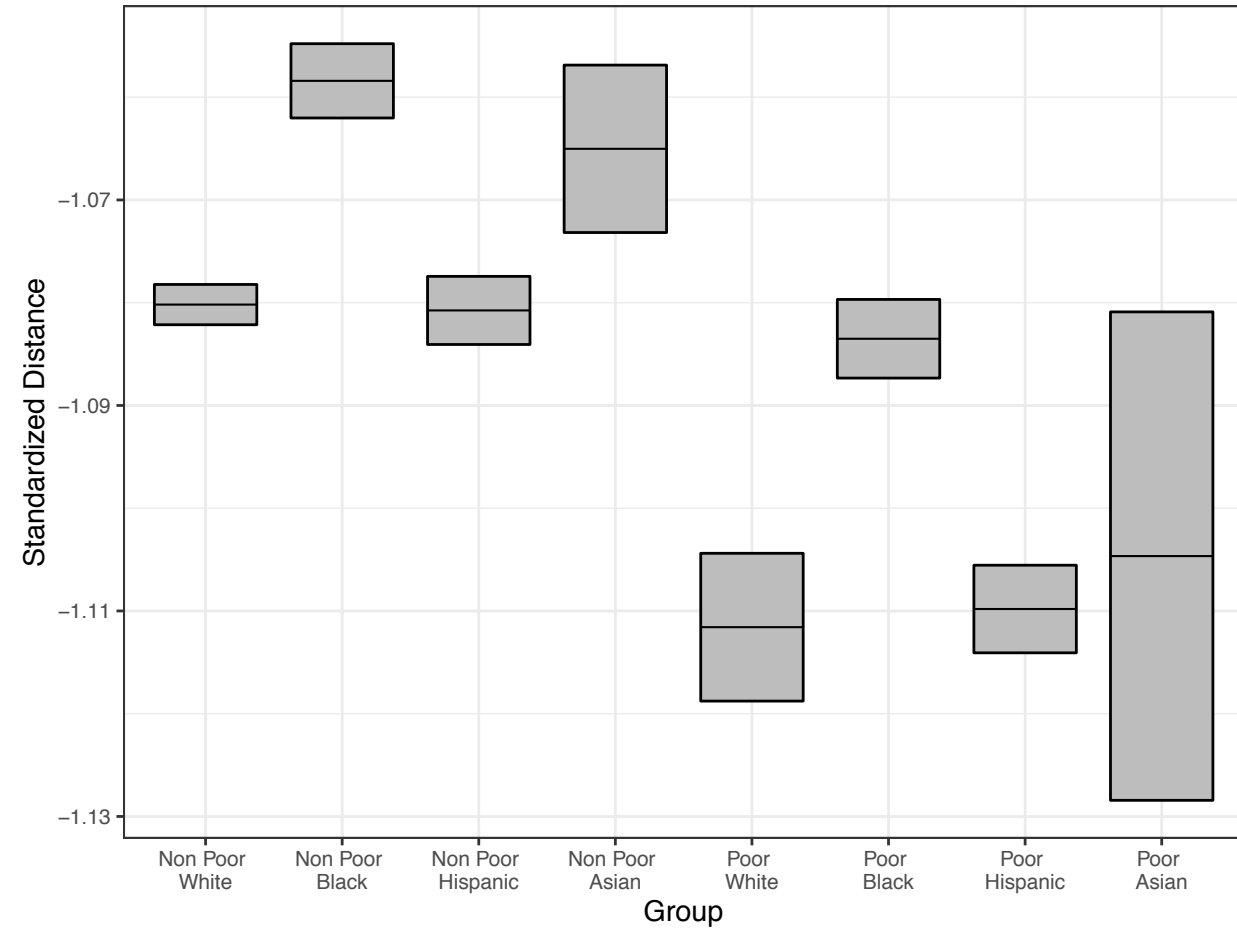
Research Design

- Travel patterns of residents from White, Black, Hispanic, Asian, non-poor and poor neighborhoods
 - Race/ethnicity > 50%
 - Households living under the poverty level > 30%
 - Tested higher thresholds (60% and 40%)
 - 2014-2018 American Community Survey

Proportion of trips



Average distance travelled



Levels of exposure to $PM_{2.5}$

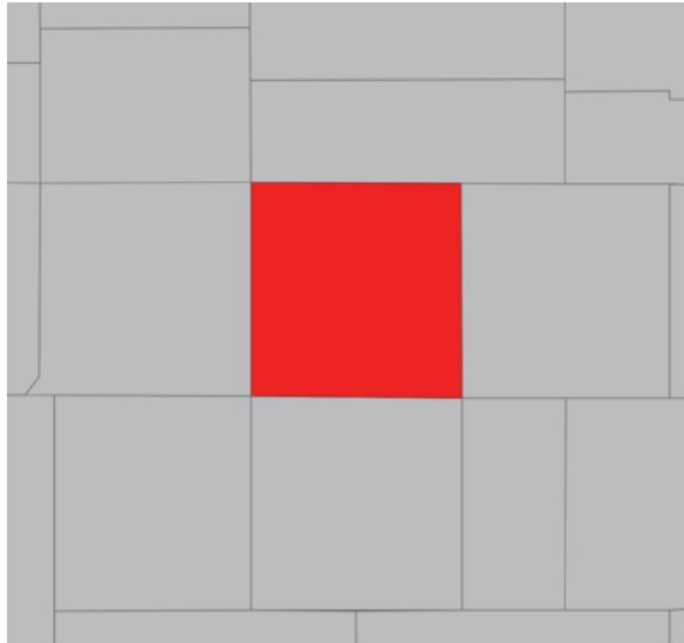
- Environmental Protection Agency's EJScreen

$$Y_{ik} = \beta_0 + \beta_1 White_{ik} + \beta_2 Black_{ik} + \beta_3 Asian_{ik} + \beta_4 Hisp_{ik} + \beta_5 Poor_{ik} + \beta_6 Pop_{ik} + \alpha_k + \varepsilon_{ik}$$

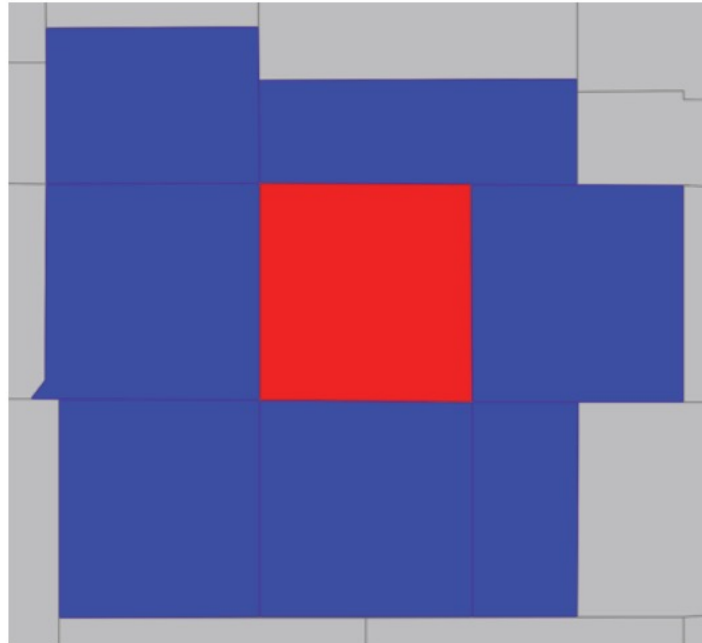
Y_{ik} is the $PM_{2.5}$ at the

1. Residential
2. Adjacent
3. Network

Residential



Adjacent

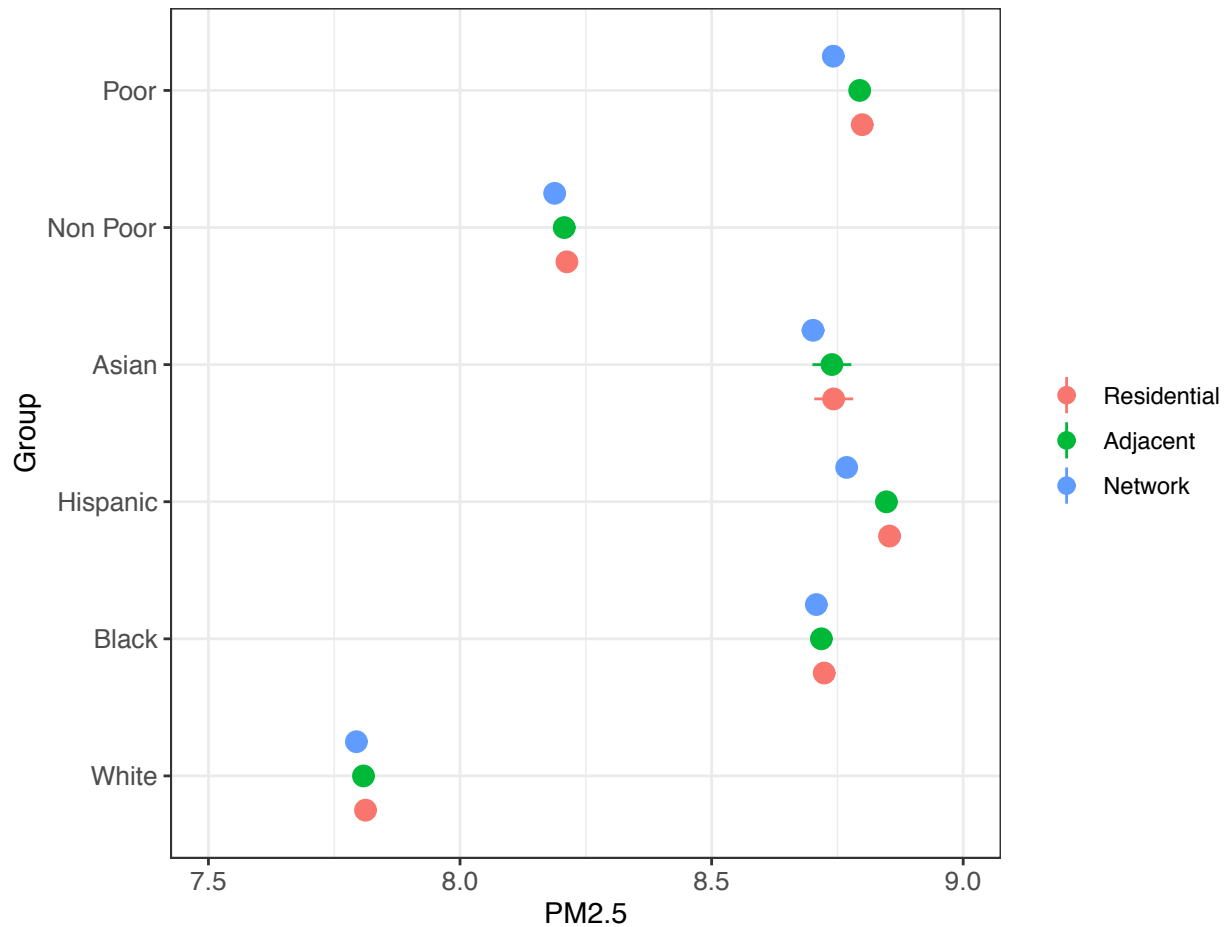


Network
(non-residential
and non-adjacent)



Higher levels of $PM_{2.5}$ levels in non-white and poor

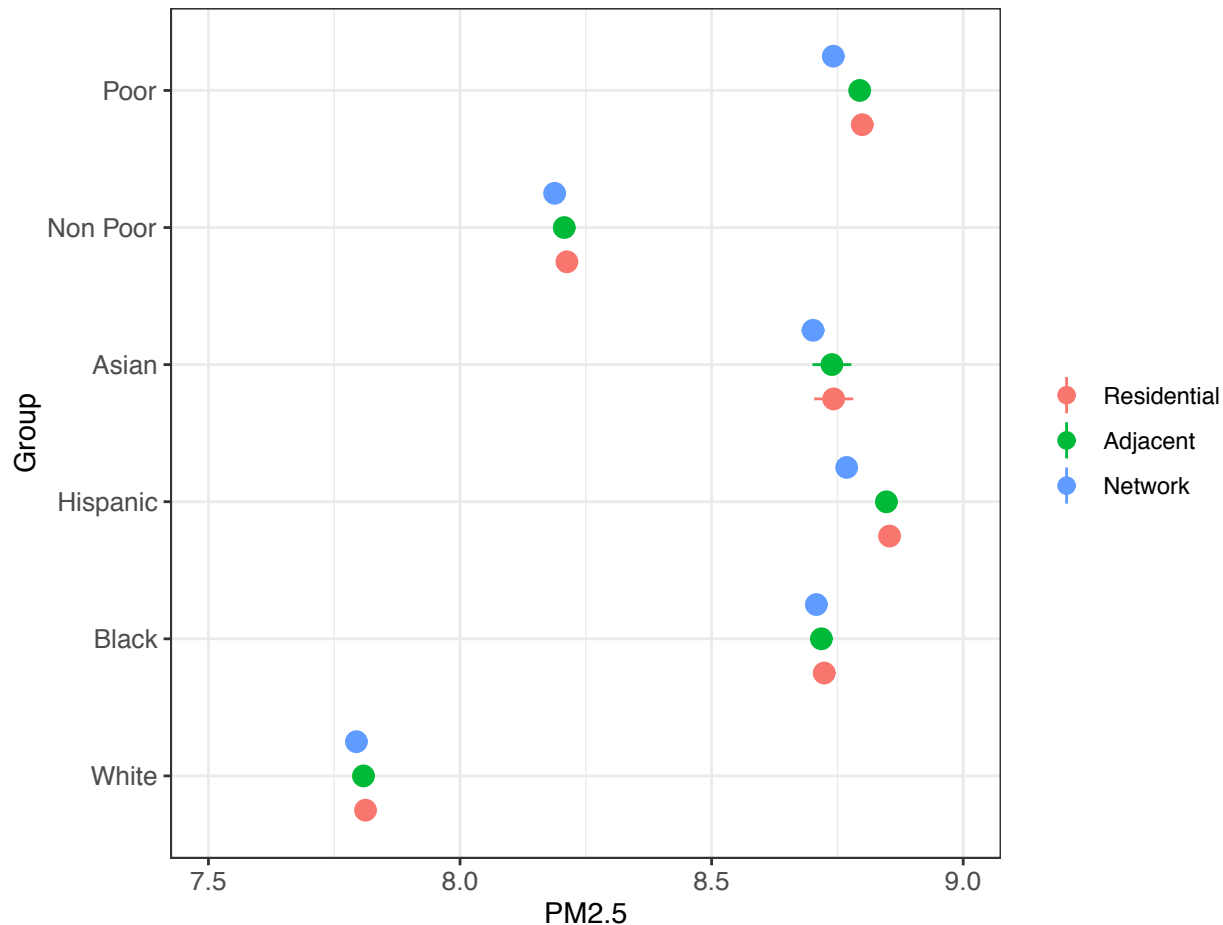
- Residential
- Adjacent



Higher levels of $PM_{2.5}$ levels in non-white and poor

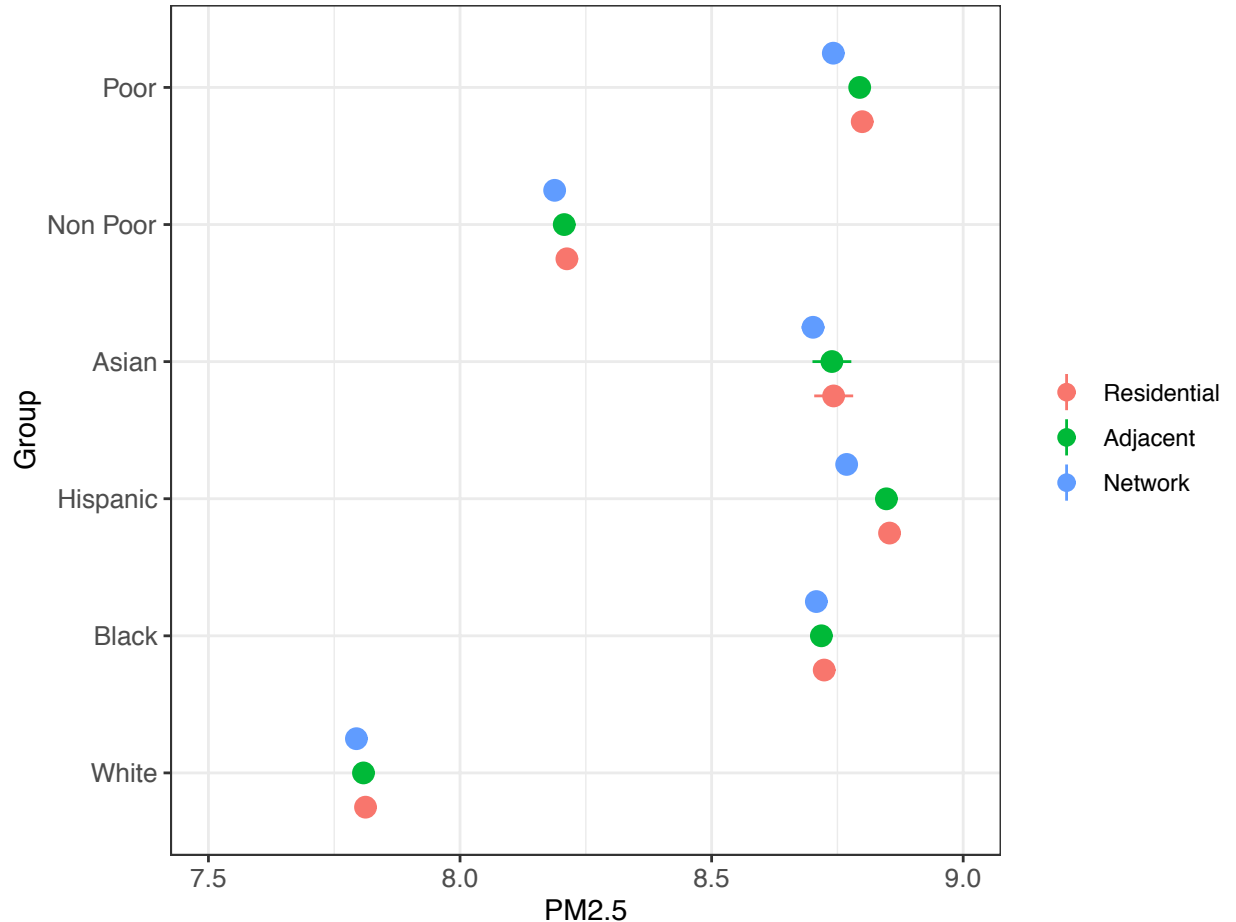
- Residential
- Adjacent
- Network

Hispanic neighborhoods exhibit the greatest burden



Network neighborhood inequality in comparison to residential and adjacent is

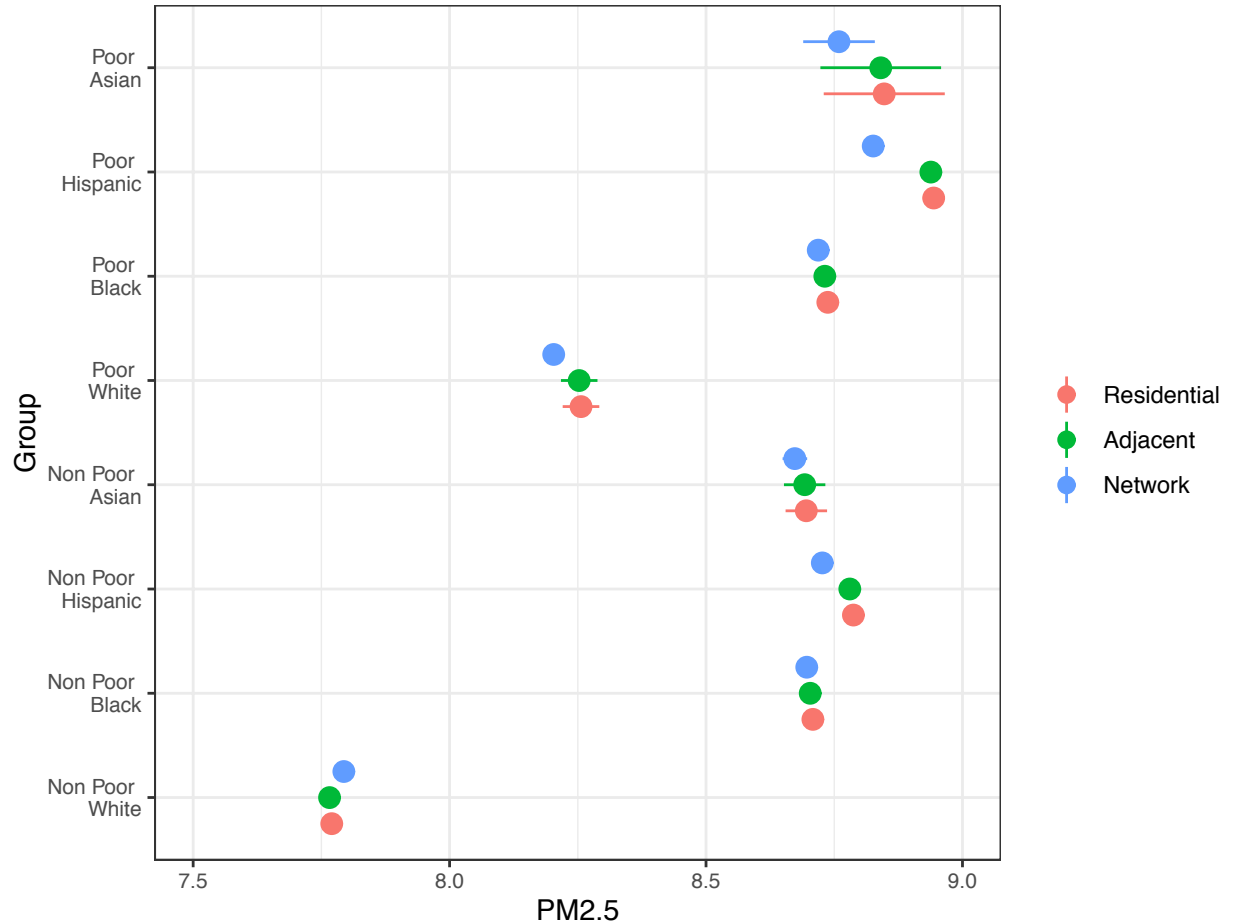
- Lower
 - White/Hispanic
 - Non-poor/Poor
- Higher
 - White/Black
 - White/Asian



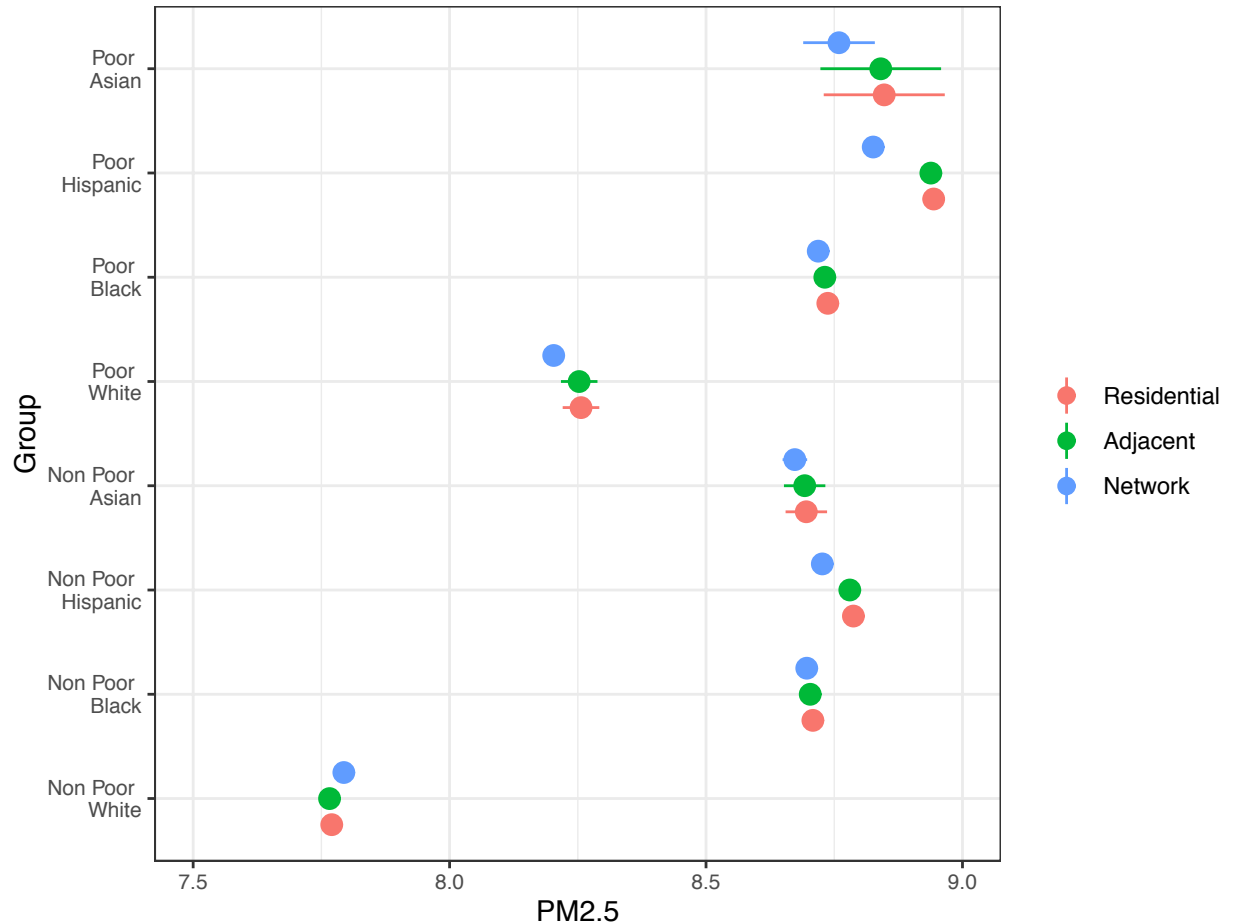
Non-poor vs poor

- Lower $PM_{2.5}$
 - All scales
 - All race/ethnicity

Greater socioeconomic advantage for White neighborhoods



- Black and Asian
 - Similar $PM_{2.5}$ across all scales for poor and non-poor
- Hispanic
 - Lower at the network for poor and non-poor
 - Greater decrease for poor
- White
 - Lower at the network for poor
 - Higher at the network for non-poor



Caveats

- Census tracts may be too large in some cases
- Data at the neighborhood level not individual level
- Trips to points of interest
- Differences may be partly due to own and travels with cell phone
- Time spent at location and activity
- Visits of unique devices in a day

Conclusion

- Underestimate neighborhood inequalities by ignoring where residents travel to throughout the day
- Policies consider the network of neighborhoods that residents visit
 - e.g. Target interventions in the most polluted *and* visited neighborhoods

Thank You!

Questions?

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