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# Spatial Disparities in the Distribution of Parks and Green Spaces in the United States

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# Key Research Questions

- Is spatial access to public parks and green spaces linked to neighborhood socioeconomic status and racial and ethnic composition?
- Empirically, are there variations in these associations according to geographic aggregation used to define neighborhood?

# Background

- **Sedentary lifestyle**

  **- About half of U.S. adults do not meet the federal aerobic physical activity guidelines.**

  **- Ethnic minorities are less likely to exercise than whites.**

  **- Socioeconomic status (SES) is another important correlate but not much of a mediator of the race/ethnic disparities.**

- **The built environment**

  **- Definition: "human-formed, developed, or structured areas"**

  **- Examples: places to go to do things or exercise (e.g., parks), inviting features (e.g., green spaces), walkability**

# Background

- **Environmental justice framework**

  **- Principle: All people and communities are entitled to equal distributions of environmental amenities and no group should be disproportionately affected by environmental hazards.**

  **- Less focused on "environmental goods"**

  **- Low income and minority individuals are more exposed to environmental hazards**

- **It follows to hypothesize that groups' differential exposure to the built environment may contribute to PA disparities by race/ethnicity and income.**

  **- This hypothesis has not been well examined.**

# Literature Review

- **Benefits of parks and green spaces**
- **Neighborhood socio-demographic features are intertwined.**
- **Are neighborhood socio-demographic features also linked to the built environment?**
  - **Mixed evidence from regional or local studies**
  - **National analyses lacking**
- **The health disparity literature is more focused on individuals rather than places *per se***

# Neighborhood Unit

- **Modifiable areal unit problem**

  **- Which geographic scale should be used at the unit of analysis?**

  **- Widely acknowledged**

  **- Multiple units analyses recommended but rarely employed**
- **Smaller units may more reflect neighborhood processes**
- **Larger units may more reflect macro-political processes**

# Data

- Census 2000

  - Socio-demographic variables

- Public park data from ESRI (2009)

  - Access to local parks

- Green space data from the National Land Cover Database (2001)

  - Access to green spaces

- Geographic level

  - Census tract (neighborhood): immediate area around one's residence

  - County (larger geographic aggregation)

# Dependent Variable

- **Access to park**

  - Measured by population size and park size weighted flying distance from the neighborhood centroid to the nearest seven parks

  - Reference: “Zhang XY, Lu H & Holt JB. 2011. “Modeling spatial accessibility to parks: A national study” *International Journal of Health Geographics* 10:31.”

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# Distance to Park

- **Distance to Park:**

  - Census block group centroid

  - Flying spatial distance (miles) from the geographic centroid of the tract to the geographic centroid of each of the seven identified parks.

  - Park access potential index (API), a ratio of 'park size/square of flying distance to park for each park'

  - The probability of accessing this particular park: $API_i/Sum(API)$

  - Person distance to local parks: Sum of [($API_i/Sum(API)$ Pop Size $Distance_i$], $i$ = 1-7

  - Aggregate to census tract and county levels.

# Dependent Variable

- **Access to green spaces:**

  **- The tree canopy density is represented as the percentage of area covered by tree canopy within each 30m pixel.**

  **- Aggregate green space measures were generated at the county and census tract levels.**

  **- The green space measure captures the proportion of land in a neighborhood covered by vegetation.**

# Independent Variables
*(standardized)*

- **Neighborhood SES**
  - percentage of residents in poverty
- **Minority composition**
  - percentage of blacks
  - percentage of Hispanics
- **Controls**
  - population density
  - percentage of rural residents

# Statistical Method

- A national ecological and cross-sectional study
- Unit of analysis: US census tracts and counties
- GIS used to construct access to parks and green spaces
- Multiple OLS regression analyses performed to examine the research questions

# Findings: OLS Regression on Distance to Parks

| | Tract-level | County-level |
|---|---|---|
| Percentage of residents in poverty | 0.16 | 0.32 |
| | (0.16 - 0.17)** | (0.28 - 0.36)** |
| Percentage of blacks | -0.09 | -0.12 |
| | (-0.10 - -0.09)** | (-0.16 - -0.09)** |
| Percentage of  Hispanics | -0.09 | -0.03 |
| | (-0.10 - -0.08)** | (-0.06 - 0.00) |
| Population density | -0.12 | -0.06 |
| | (-0.12 - -0.11)** | (-0.10 - -0.03)** |
| Percentage of rural residents | 0.48 | 0.25 |
| | (0.47 - 0.49)** | (0.22 - 0.29)** |
| Constant | 0.00 | 0.00 |
| | (-0.01 - 0.01) | (-0.03 - 0.03) |
| Observations | 64,562 | 3,109 |
| R-squared | 0.32 | 0.21 |

95% confidence intervals in parentheses; ** significant at 5%; *** significant at 1%

# Findings: OLS Regression on Access to Green Spaces

| | Tract-level | County-level |
|---|---|---|
| Percent of residents in poverty | -0.03 | 0.19 |
| | (-0.04 - -0.03)** | (0.15 - 0.23)** |
| Percent blacks | -0.07 | 0.14 |
| | (-0.08 - -0.06)** | (0.10 - 0.17)** |
| Percent Hispanics | -0.22 | -0.32 |
| | (-0.23 - -0.21)** | (-0.36 - -0.29)** |
| Population density | -0.14 | -0.07 |
| | (-0.15 - -0.13)** | (-0.10 - -0.04)** |
| Percent of rural residents | 0.30 | -0.07 |
| | (0.29 - 0.31)** | (-0.10 - -0.03)** |
| Constant | 0.00 | -0.00 |
| | (-0.01 - 0.01) | (-0.03 - 0.03) |
| R-squared | 0.24 | 0.16 |
| Observations | 64,562 | 3,109 |

95% confidence intervals in parentheses; ** significant at 5%; *** significant at 1%

# Summary: OLS Regression

| | Distance to Parks | | Green Space Access | |
|---|---|---|---|---|
| | Tract-level | County-level | Tract-level | County-level |
| Percentage of residents in poverty | + | + | - | + |
| Percentage of blacks | - | - | - | + |
| Percentage of Hispanics | - | - | - | - |
| Population density | - | - | - | - |
| Percentage of rural residents | + | + | + | - |
| $R^2$ | 0.32 | 0.21 | 0.24 | 0.16 |

# Summary

- Distance to parks
  - Consistent with hypotheses: poverty (+)
  - Inconsistent with hypotheses: % blacks (-), % Hispanics (-)
  - Controls: pop density (-), % rural residents (+)
  - No cross-unit variation
- Access to green spaces
  - Consistent with hypotheses: poverty_Tract (-), % blacks_Tract (-), % Hispanics (-)
  - Inconsistent with hypotheses: poverty_County (+), % blacks_County (+)
  - Controls: pop density (-), % rural residents_Tract (+), % rural residents_County (-)
  - Cross-unit variations observed
- Access to parks and access to green spaces are negatively correlated at the tract level but positively at the county level

# Discussion

- Variations of spatial distribution of parks and green spaces do not follow a straightforward inequality paradigm predicting built environmental disadvantage following socioeconomic deprivation.
- Cross-unit variations
- Weaker correlations and smaller $R^2$ at the county level
- More complex picture for green space access

  - Smaller $R^2$ compared to that for park access

  - The cross-level variations may be due to different mechanisms operating at different scales.

# Limitations

- Cross-sectional (but with a temporal sequence in the data)
- No causality can be determined
- Crude measures for park and green space access
- Processes not examined
- Other levels of analyses should be explored to further test the sensitivity of these findings to geographic scales.

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# Disclaimer

- The findings and conclusions in this study are those of the authors and do not necessarily represent the official position of National Institute of health (NIH) and the Centers for Disease Control and Prevention (CDC).