Male incarceration rates, spatial access to sexual health care, and sexually transmitted infections: A moderation analysis

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Rates of Sexually Transmitted Infections (per 100,000), 2013

National  Georgia

- P&S Syphilis: 5.5  10.3
- Gonorrhea: 106.1  143.7
- Chlamydia: 446.6  514.8

(Source: CDC, 2014)
Factors Hypothesized to Shape STI Rates

Rates of Incarceration (per 100,000), 2013

- National: 478.0
- Georgia: 540.3

Incarceration Health Care Service Environment

- Testing and Treatment
- Spatial access to health care (e.g. travel time, distance)
- Shapes health care utilization
- Determinant of treatment seeking behavior
- Empirical evidence is conflicting

(ex. The Sentencing Project, 2014; The Sentencing Project, 2008; Georgia Department of Corrections, 2010; Acury et al., 2005; Dorrell et al., 2011; Mosen et al., 1998; Aral et al., 2008; Mercer et al., 2007; Olonilua et al., 2008; Bonney et al., 2011; Fortney, 2000; Mays, 2000)
Research Aim and Hypothesis

- **Aim:**
  - Explore health care service availability as a moderator of the relationship between male incarceration and STIs, 2010

- **Hypothesis:**
  - Greater spatial access to sexual health care will decrease the magnitude of the relationship between rates of male incarceration and rates of STIs.
Methods

**Sample**

Atlanta, GA
(n=946)

**Variables**

- **2010**

- **Dependent variable**
  - Rate of STIs (Chlamydia, gonorrhea, P&S syphilis)

- **Independent variables**
  - Rate of male incarceration
  - Spatial access to a sexual healthcare facility
    - Euclidian distance

- **Control variables**
Methods

Analysis

- Univariate & bivariate analyses

- Regression Model
  - Rate of male incarceration + Spatial access to care → prevalence of STIs

- Moderation Models (Baron and Kenny, 1986)
  - Unadjusted moderation model
  - Multivariate moderation model
    - Controlling for covariates (p <0.05)

- Stratified regression
  - Quartiles of spatial access to sexual health facilities

- SAS
## Results

Table 1. Distributions of census-tract level characteristics in the Atlanta MSA, 2010 (N=946)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Incarceration Rate</td>
<td>4.63 (5.25)</td>
</tr>
<tr>
<td>Euclidean distance (in miles) to nearest sexual health facility</td>
<td>0.42 (0.35)</td>
</tr>
<tr>
<td>Rate of newly-diagnosed STIs</td>
<td>11.30 (12.00)</td>
</tr>
</tbody>
</table>
Figure 1. Maps depicting the distance to the nearest sexual health facility, male incarceration rate and prevalence of newly-diagnosed STIs in the Atlanta MSA, 2010 (N=946)
### Table 2. Base model and moderation model examining the moderation effect of spatial access to sexual health care on tract-level rate of male incarceration and tract-level prevalence of newly-diagnosed STIs in the Atlanta MSA, 2010

<table>
<thead>
<tr>
<th></th>
<th>Base Model</th>
<th></th>
<th>Moderation Model</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE B</td>
<td>B</td>
<td>SE B</td>
</tr>
<tr>
<td>Rate of male incarceration</td>
<td>1.44</td>
<td>0.06***</td>
<td>0.69</td>
<td>0.06***</td>
</tr>
<tr>
<td>Euclidean distance to closest sexual health care service (in miles)</td>
<td>-81.91</td>
<td>9.21***</td>
<td>37.90</td>
<td>11.99**</td>
</tr>
<tr>
<td>Rate of male incarceration* Euclidean distance to closest sexual health care service</td>
<td>---</td>
<td>---</td>
<td>-10.63</td>
<td>2.14***</td>
</tr>
<tr>
<td>R² F</td>
<td>0.53</td>
<td>435.47**</td>
<td>0.78</td>
<td>266.32***</td>
</tr>
</tbody>
</table>

*p < 0.05, **p < 0.01, ***p < 0.001 Note: Moderation model controlled for % living in poverty, % non-Hispanic Black, median age, % in the armed forces, % married, % whose highest educational attainment is high school and % unemployed.
Table 3. Regression models exploring rate of male incarceration and tract-level prevalence of newly-diagnosed STIs in the Atlanta MSA, stratified by spatial access to sexual health care and adjusted for covariates, 2010.

<table>
<thead>
<tr>
<th>Model Characteristics</th>
<th>B</th>
<th>SE B</th>
<th>R²</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>25% Shortest Distance to Nearest Sexual Health Facility</td>
<td>Rate of male incarceration</td>
<td>0.49</td>
<td>0.11***</td>
<td>0.73</td>
</tr>
<tr>
<td>50% Distance to Nearest Sexual Health Facility</td>
<td>Rate of male incarceration</td>
<td>0.32</td>
<td>0.11**</td>
<td>0.81</td>
</tr>
<tr>
<td>75% Distance to Nearest Sexual Health Facility</td>
<td>Rate of male incarceration</td>
<td>0.17</td>
<td>0.16</td>
<td>0.81</td>
</tr>
<tr>
<td>&gt; 75% Furthest Distance to Nearest Sexual Health Facility</td>
<td>Rate of male incarceration</td>
<td>0.08</td>
<td>0.10</td>
<td>0.80</td>
</tr>
</tbody>
</table>

*p < 0.05, **p < 0.01, ***p < 0.001 Note: Moderation model controlled for % living in poverty, % non-Hispanic Black, median age, % in the armed forces, % married, % whose highest educational attainment is high school and % unemployed.
Discussion

- Spatial access to sexual health care is an effect modifier
  - As spatial access worsened, the magnitude of the association decreased

- In areas with the best spatial access:
  - Male incarceration predicted a positive increase in prevalence of STIs
Discussion

Spatial access to health care

- Effect modifier but not as expected
- Additional “costs” of accessing health care

Rates of incarceration

Sexual health outcomes

Spatial access to health care

(ex. Acury et al., 2005; Dorrell et al., 2011; Mosen et al., 1998; Aral et al., 2008; Mercer et al., 2007; Penchansky & Thomas, 1981; Haynes, 2003)
## Concluding Remarks

### Future Research
- Types of health care facilities
- Overwhelming impact of male incarceration
  - Disparities in health care utilization
- Convenience and utilization

### Implications for Practice
- Improve accessibility for vulnerable groups
- Health care providers to be informed about the environments in which their patients live
Acknowledgements

- NIMH grant “Male incarceration, the health care service environment and sexual health” (F31 MH096630)

- NIDA T32 postdoctoral fellowship “HIV and Other Consequences of Substance Abuse” (T32 DA013911; Flanigan, PI)

- NIDA R25 Lifespan/Brown “Criminal Justice Research Program on Substance Use, HIV, and Comorbidities” (R25 DA037190; Beckwith, PI)

- Laney Graduate School, Emory University

- Center for Digital Scholarship, Emory University
Thank you!


References


References


Methods – Measures

Dependent Variable:

- Prevalence of Chlamydia, gonorrhea, and P&S syphilis
  - Suppressed data (<5 cases)
  - Aggregated

- STI prevalence rate = (# of STIs / Adult population) * 1,000

Source: Georgia Department of Community Health
**Methods – Measures**

### Independent Variables

**Rate of Male Incarceration**
- Rate of male incarceration
  - Individual inmate records
- Geocoded addresses
  - ArcGIS
  - Google Earth Pro
  - N = 25,926

**Spatial Access to Care**
- Sexual Health Facility
  - STI testing, treatment and/or vaccination
- Sexual Health Facility Inventory
  - Comprehensive internet search
  - Surveying local health care providers
  - Consulting ACOG
  - Title X funding
- Geocoded
- Spatial access
  - Equity Index
  - Euclidean distance
    - Population-weighted centroid
    - Higher values indicate further distance
- ArcGIS

Source: Georgia Department of Corrections
Quantitative Methods – Measures

Control Variables

- Tract-level
  - % of residents who identified as non-Hispanic Black/ African-American
  - % unemployed
  - % in armed forces
  - Median age
  - % living in poverty
  - % of residents who are married
  - % of residents aged ≥ 25 years whose highest educational attainment is high school

Source: American Community Survey; U.S. Census Bureau
Supplemental Table 1. Regression models exploring rate of male incarceration and tract-level prevalence of newly-diagnosed STIs in the Atlanta MSA, stratified by spatial access to sexual health care and adjusted for covariates, 2010.

<table>
<thead>
<tr>
<th>Rate of Male Incarceration</th>
<th>Model Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD)</td>
<td>B</td>
</tr>
<tr>
<td>25% Shortest Distance to Nearest Sexual Health Facility</td>
<td>6.74 (8.18)</td>
</tr>
<tr>
<td>Rate of male incarceration</td>
<td>0.49</td>
</tr>
<tr>
<td>50% Distance to Nearest Sexual Health Facility</td>
<td>5.09 (4.81)</td>
</tr>
<tr>
<td>Rate of male incarceration</td>
<td>0.32</td>
</tr>
<tr>
<td>75% Distance to Nearest Sexual Health Facility</td>
<td>3.77 (3.11)</td>
</tr>
<tr>
<td>Rate of male incarceration</td>
<td>0.17</td>
</tr>
<tr>
<td>&gt; 75% Furthest Distance to Nearest Sexual Health Facility</td>
<td>3.15 (1.98)</td>
</tr>
<tr>
<td>Rate of male incarceration</td>
<td>0.08</td>
</tr>
</tbody>
</table>

*p < 0.05, **p < 0.01, ***p < 0.001 Note: Moderation model controlled for % living in poverty, % non-Hispanic Black, median age, % in the armed forces, % married, % whose highest educational attainment is high school and % unemployed.
**Supplemental Table 2: Sensitivity Analysis**

<table>
<thead>
<tr>
<th></th>
<th>Model A (set to 0)</th>
<th></th>
<th>Model B (set to 4)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE B</td>
<td>B</td>
<td>SE B</td>
</tr>
<tr>
<td>Rate of male incarceration</td>
<td>0.70</td>
<td>0.06***</td>
<td>0.71</td>
<td>0.06***</td>
</tr>
<tr>
<td>Euclidean distance to closest sexual health care service (in miles)</td>
<td>35.03</td>
<td>10.34***</td>
<td>36.96</td>
<td>10.34**</td>
</tr>
<tr>
<td>Rate of male incarceration* Euclidean distance to closest sexual health care service</td>
<td>-10.54</td>
<td>1.94***</td>
<td>-10.72</td>
<td>1.94***</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.79</td>
<td></td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>$F$</td>
<td>318.98***</td>
<td></td>
<td>309.91***</td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.05, **p < 0.01, ***p < 0.001 Note: Moderation model controlled for % living in poverty, % non-Hispanic Black, median age, % in the armed forces, % married, % whose highest educational attainment is high school and % unemployed.
Limitations

- Census tracts as neighborhood proxy
- Male incarceration address data
- Measure of spatial access
- Health care service inventory

(ex. Anderson, 1996; Apparicio et al., 2008; O’Campo, 1997; Gindi, 2011)
## Concluding Remarks

### Future Research
- Types of health care facilities
- Overwhelming impact of male incarceration
  - Disparities in health care utilization
- Longitudinal analyses
- Convenience and utilization

### Implications for Practice
- Location of STI-prevention programs/outreach
- Improve accessibility for vulnerable groups
- Health care providers to be informed about the environments in which their patients live