Where Have All the Men Gone?
The Impact of Imbalanced Sex Ratios on High-Risk Sexual Behaviors

October 18, 2010

River A. Pugsley, MPH
Virginia Department of Health, Office of Epidemiology, Division of Disease Prevention
Virginia Commonwealth University, Department of Epidemiology and Community Health
Outline

• Background
  – Disparities in STDs
  – Social determinants of health
  – Sex ratio theory

• Methods
  – Data sources
  – Analysis

• Results
  – Bivariate
  – Multi-level

• Conclusions
STD Disparities

• The epidemiology of STDs in the US continues to be characterized by immense inequality in the burden of disease.
  – Racial
  – Geographic
  – Economic
  – Education
  – Incarceration
  – Sexual orientation (in some areas)
Racial Disparities - Gonorrhea

- Rate among blacks are approximately 20 times greater than the rates among whites.
- This extreme variance in STD rates is one the greatest racial disparities observed for any disease.

Geographic Disparities - Gonorrhea

Poverty, Race/Ethnicity and Gonorrhea


Note. Gonorrhea rates were calculated using case counts weighted for race/ethnicity. Error bars show 95% confidence intervals calculated with the exact Poisson method. Census tract and population count data for California were collected as part of the 2000 US Census and obtained from the US Census Bureau.

FIGURE 1—Gonorrhea infection rates, by race/ethnicity and percentage of census tract residents living below the poverty line: California, 2004-2006.
Disparities and Contextual Factors

- Disparities continue to persist despite dedicated amelioration efforts.
- Some prevention efforts have shifted focus from individual-level risk factors to various contextual factors, such as:
  - poverty and economic disadvantage
  - social norms
  - segregation
  - incarceration rates
  - population composition
Social Determinants

**Fig. 1.** Conceptual model of the relationship between social determinants of health and STD. Social determinants interact with societal norms and pathogen characteristics to influence the epidemiologic context (indicated via the right-hand arrow). The epidemiologic context interacts with behaviors to influence the nature or odds of STD acquisition or transmission (indicated via the left-hand arrow). The broader constructs (larger circles) do not completely occlude the smaller because other influences also operate upon STD rates and epidemiology.

Hogben & Leichliter, 2008
Neighborhood Context

- Neighborhood contextual factors may have an influence on individual sexual risk behaviors and subsequently STD rates.
  - Not normally targeted in STD prevention campaigns
- Identification of geographic areas associated with high-risk sexual behaviors and STD rates can be targeted for STD prevention efforts.
  - Using GIS technologies to identify geographic areas with elevated disease burden has been shown to enhance disease prevention efforts.
Sex Ratios

• Low male-to-female sex ratios, in which there is a relative shortage of men in the population, has been associated with…
  – elevated STD incidence at the population level
  – increased engagement in risky sexual behaviors at the individual level

• The large disparities observed between black and white Americans in terms of income, health status, and other socio-economic measures are also observed for sex ratios.

Hogben & Leichliter, 2008; Pouget et al, 2010; Thomas & Gaffield, 2003; Lane et al., 2004; Aral, 1996; Kilmarx et al., 1997; Thomas & Sampson, 2005
Sex Ratios by Race

• Based on 2009 U.S. Census estimates the ratio of all males to females in the U.S. is:
  – 0.98 among whites
  – 0.91 among blacks

• Sex ratios in the reproduce age range (15-49 years) range from:
  – 1.05 among whites
  – 0.95 among blacks

• In racially segregated and economically deprived communities, which also experience the highest STD rates, this ratio is often much lower.
Causes of Low Sex Ratios

• Combination of several social and economic forces
  – Birth rates generally higher for males
  – Males have higher death rates relative to females across almost all age groups
    • Premature death rates among blacks tend to be significantly higher than among whites
    • Differential environmental exposures and health care access
    • High crime rates and violent deaths
  – Incarceration rates are disproportionately high among black men, resulting in a type of non-voluntary or forced migration out of communities.
Crime and Incarceration

• According to 2008 statistics from the U.S. Department of Justice:
  – Black males were imprisoned at a rate six and a half times higher than white males.
  – Approximately 7 percent of the total black male population between the ages of 25 to 29 was incarcerated.

• High crime and incarceration rates are especially concerning with regard to STD prevention efforts as they have been associated with
  – increases in both teenage pregnancy and STD rates at the population-level
  – increased engagement in high-risk sexual behaviors at the individual-level
Impact of Low Sex Ratios

• At the population level, low male-to-female sex ratios have been linked to:
  – lower rates of marriage
  – increased rates of divorce
  – greater familial instability
  – higher rates of teenage pregnancy
  – increased incidence of STDs

• Conceptually, shifts in the balance of power in opposite-sex relations may mediate the observed impact of sex ratios on social norms and behavior.
Social Exchange Theory

• Theory used to the influence of sex ratios on sexual partnering dynamics
  – Posits that all human relationships are based on subjective cost-benefit analyses and the comparison of alternatives.

• A shortage of men…
  – Reduces women’s dyadic power in interpersonal relationships by reducing the available alternative relationships for women
  – Increases men’s dyadic power by increasing the available alternative relationships for men.

• Low sex ratios disrupt the balance of power between men and women, placing women at a disadvantage in sexual relations.
Sex Ratios and Behaviors

- In communities where males are in short supply, studies have indicated that men are more likely to have multiple sexual partners, and women are less likely to insist on condom use.
- Both of these behaviors contribute substantially to increased transmission of STDs within social groups, as well as elevated individual risk of acquiring a STD.

Adimora et al., 2001; Ferguson et al., 2006; Uecker & Regnerus, 2010; Thomas & Thomas, 1999; Adimora & Schoenbach, 2005; Pouget et al, 2010
High-Risk Sexual Behaviors

• Multiple sexual partnerships and concurrency have been implicated as important indicator of elevated STD risk at both the individual and population levels
  – Number of sex partners is the single most important risk factor for getting a sexually transmitted disease (National Health and Social Life Survey)
  – At the population level, concurrent sexual partnerships can dramatically accelerate the spread of STDs through a population

• Condom use effective at preventing spread of STDs
Previous Qualitative Research

• Focus group studies
  – Indicated gender imbalance is a key component of sexual interactions between men and women
  – Perceived shortage of males impacts relationship attitudes, results in decreased dyadic power for women, and is at least partly responsible for the prevalence of concurrent sexual partnerships

Adimora *et al.*, 2001; Ferguson *et al.*, 2006; Uecker & Regnerus, 2010; Glenn & Marquardt, 2001; Bogle, 2008; Williams, 2010
Previous Ecological Research

- At the population or ecological level, studies have generally found that low male-to-female sex ratios, or high male incarceration rates, are associated with high STD rates.
  - This association does not always persist when controlled for other variables, such as poverty and marriage rates, and the association varies across different diseases.

Kilmarx et al., 1997; Thomas and Gaffield, 2003; Thomas and Sampson, 2005; Hogben & Leichliter, 2008; Lane et al., 2004; Aral, 1996
Previous Multi-Level Research

- Smith and Subramanian (2006) – Australia
  - Sex ratio was associated with the number of sexual partners in the previous year
  - Did not account for differential effects on men and women
- Pouget et al. (2010) – U.S. (county level)
  - Both sex ratios and incarceration rates at the county level associated with the reported number of opposite-sex partners.
  - Black men in particular had significantly higher odds of having two or more sex partners in the past year.
- Senn et al. (2010) – U.S. (census tract level)
  - Among the male STD clinic patients, no association was found between sex ratio and number of opposite-sex partners in the last three months.
  - For women, number of sexual partners actually increased as the sex ratio increased, although the researchers noted that this association was largely driven by women reporting trading sex.
Current Study

• **Purpose:**
  - Investigate the association between low male-to-female sex ratios at the population level and individual high-risk sexual behaviors.

• **Hypothesis:**
  - Low male-to-female sex ratios lead to increases in risky sexual behaviors such as multiple sex partners and lack of condom use
  - Differential effect of sex ratio by gender, such that lower ratios are associated with:
    • a greater number of sexual partners among men
    • reduced condom use among women
Study Setting: Richmond, VA

- Metropolitan area located in central Virginia.
- Richmond City has relatively high proportions of black persons (53.1%) and persons living below the federal poverty level (22.4%) compared to the surrounding counties of Henrico and Chesterfield.

Data Sources
Study Setting: STD Rates

- Richmond City has a disproportionately high STD burden.
  - Gonorrhea rate in 2007: 612.2 per 100,000
    - 5.1 times the national average
    - Approx. 7.5 times the state average
    - 7.5 times the rate in Chesterfield County
    - 5.0 times the rate in Henrico County
  - These large differences in rates within the same metropolitan area lend themselves to further study of the geographic and social factors involved.
### Table 2. Chlamydia and Gonorrhea Rates by Geographic Region and Year, 2003-2007

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chesterfield County</td>
<td>200.8</td>
<td>192.6</td>
<td>195.5</td>
<td>232.3</td>
<td>253.8</td>
<td>84.5</td>
<td>78.8</td>
<td>73.9</td>
<td>63.7</td>
<td>81.2</td>
</tr>
<tr>
<td>Henrico County</td>
<td>277.4</td>
<td>324.8</td>
<td>277.1</td>
<td>295.1</td>
<td>359.7</td>
<td>136.1</td>
<td>123.7</td>
<td>118.3</td>
<td>104.8</td>
<td>121.7</td>
</tr>
<tr>
<td><strong>Richmond City</strong></td>
<td>1054.3</td>
<td>1208.4</td>
<td>1172.0</td>
<td>1134.3</td>
<td>1178.8</td>
<td>641.4</td>
<td>588.1</td>
<td>690.4</td>
<td>458.3</td>
<td>612.2</td>
</tr>
<tr>
<td>Virginia (State)</td>
<td>263.2</td>
<td>290.0</td>
<td>299.5</td>
<td>315.2</td>
<td>321.6</td>
<td>122.7</td>
<td>114.8</td>
<td>110.3</td>
<td>84.7</td>
<td>82.0</td>
</tr>
<tr>
<td>National (U.S.)</td>
<td>301.7</td>
<td>316.5</td>
<td>329.4</td>
<td>344.3</td>
<td>370.2</td>
<td>115.2</td>
<td>112.4</td>
<td>114.6</td>
<td>119.7</td>
<td>118.9</td>
</tr>
</tbody>
</table>

Data Sources

- Virginia (State)
- National (U.S.)
Individual-Level Data Source

• STD Surveillance Network (SSuN)
• National program to enhance STD surveillance capacity
• Traditional Case Reporting
  – Mandatory in all states
  – Typically only report
    • Sex
    • Age
    • Race
• Enhanced Surveillance
  – Patient demographics
  – STD history
  – Risk behaviors
  – Co-morbidities
Enhanced data collected as part of SSuN now captures 20% of all gonorrhea cases diagnosed in the United States annually.
SSuN Data Collection

• Three participating localities in Virginia:
  – Richmond City
  – Henrico County
  – Chesterfield County

• Demographic and behavioral risk data:
  – All patients presenting to STD clinics asked to fill out SSuN interview form during registration
  • Completion not mandatory for service
Patient-Level Variables

• Demographics
  – Age
  – Sex
  – Race/ethnicity
  – Education
  – Employment
  – Sexuality

• Risk Behaviors
  – Condom use
  – Number of partners
  – Drug use
  – Anonymous sex
  – Trade for sex

Data Sources
Data Exclusions

• Limited to data obtained from first interviews conducted during 2008-2009
• Limited to male and female genders (excludes transgender)
• Limited to heterosexual orientation (excludes gay and bisexual)
• Limited to 15-49 years of age
• Limited to Virginia residents
• Limited to NH white, NH black, and Hispanic race/ethnicity
Population-Level Data Source

• 2000 US Census
• ABSMs (census tract)
  – Sex ratio (males / females)
    • 15-49 years of age
  – Poverty (% living below poverty)
  – Education (% less than HS)
  – Racial composition (% black)
  – Marriage rates (% married)
  – Unemployment (% currently unemployed)
Operational Definitions

• Outcome Measures
  – How many sex partners have you had in the last 3 months? (1 vs. 2 or more)
  – Did you use a condom the last time you had intercourse (sex)?

• Determinant
  – Sex ratio (census tract)

• Covariates/Confounders
  – Sex
  – Race/ethnicity
  – Employment
  – Education
Geocoding Results

13,834 interview forms collected (2008-2009)

10,202 unique patients*

9,187 valid addresses (successfully geocoded)

9,145 Virginia residents

7,253 interviews included in final analysis

1,105 invalid addresses

42 out of state residents

1,892 excluded (gay/bisexual, transgender, age < 15 or > 49)

* Data from the first interview form administered was used when a patient had multiple forms completed over several visits during the time period.
Geocoding Analysis

• Variables significantly associated with invalid addresses information (& failure to geocode)
  – Age (younger)
  – Sex (males)
  – Race (Hispanic)
  – Education (less than HS)
  – Other missing data

• Not associated with outcome variables
Statistical Methods

• Bivariate Analyses
  – Population-level correlations between sex ratios and GC rates
  – Associations between high-risk sexual behaviors and all potential individual-level predictors
  – Associations between sex ratios and individual-level characteristics (including sex behaviors)

• Multi-level logistic regression
  – Binomial outcome variables: condom use, number sexual partners
  – Patient-level factors (Level 1): race/ethnicity, sex, age, education, employment
  – Census tract factors (Level 2): sex ratio
Virginia Census Tract Analysis

- For all Virginia Census tracts, significant bivariate associations were found between gonorrhea rates and the following population-level predictors:
  - Sex ratios (15-49 years of age)
  - Percent living in poverty
  - Percent black
  - Percent with less than HS education
  - Percent unemployment
Population-Level Data

- Interview respondents came from 344 census tracts
  - Average of 26.6 interviewed patients from each census tract (range 1-263)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex Ratio (15-49 years)</td>
<td>0.97</td>
<td>0.25</td>
<td>0.38</td>
<td>3.79</td>
<td>0.94</td>
</tr>
<tr>
<td>Percent Living Below Poverty</td>
<td>11.63</td>
<td>11.71</td>
<td>0.37</td>
<td>78.67</td>
<td>7.94</td>
</tr>
<tr>
<td>Percent Black</td>
<td>32.85</td>
<td>28.69</td>
<td>0.00</td>
<td>99.07</td>
<td>24.09</td>
</tr>
<tr>
<td>Percent Less Than HS Education</td>
<td>20.31</td>
<td>12.76</td>
<td>0.27</td>
<td>64.73</td>
<td>18.01</td>
</tr>
<tr>
<td>Percent Married</td>
<td>54.19</td>
<td>14.22</td>
<td>8.29</td>
<td>79.73</td>
<td>57.34</td>
</tr>
<tr>
<td>Percent Unemployed</td>
<td>5.39</td>
<td>6.23</td>
<td>0.00</td>
<td>46.56</td>
<td>3.59</td>
</tr>
</tbody>
</table>
Population-Level Data

• Because of non-normality, recategorized continuous variables into tertiles
• Significant associations found between census tract-level sex ratios and the following predictors:
  – Percent married
  – Percent living in poverty
  – Percent unemployed
  – Percent black
Mapping Population-Level Data

Figure 1. Reported Gonorrhea Incidence Rate per 100,000 by Census Tract, Richmond Area, 2000-20009

Rate per 100,000
- 0 - 166
- 167 - 725
- 726 - 2,607
- 2,608 - 8,947
- 8,948 - 30,298

Results
Mapping Population-Level Data

Figure 2. Sex Ratios for Population Aged 15-49 Years by Census Tract, Richmond Area, 2000
Mapping Population-Level Data

Figure 3. Percent of Population Currently Married by Census Tract, Richmond Area, 2000

Percent Married
- 13.4% - 34.9%
- 35.0% - 45.8%
- 45.9% - 56.3%
- 56.4% - 67.6%
- 67.7% - 79.7%
Mapping Population-Level Data

Figure 4. Percent of Population Without High School Education by Census Tract, Richmond Area, 2000

- Percent less than HS
  - 0.3% - 8.1%
  - 8.2% - 15.1%
  - 15.2% - 25.7%
  - 25.8% - 39.6%
  - 39.7% - 64.7%
Mapping Population-Level Data

Figure 5. Percent of Civilian Population Unemployed by Census Tract, Richmond Area, 2000

- Percent Unemployed
  - 0.0% - 2.6%
  - 2.7% - 4.9%
  - 5.0% - 8.9%
  - 9.0% - 19.6%
  - 19.7% - 46.6%
Mapping Population-Level Data

Figure 6. Percent of Population Living Below the Poverty Level by Census Tract, Richmond Area, 2000

Percent Below Poverty Level
- 0.4% - 5.9%
- 6.0% - 14.4%
- 14.5% - 27.2%
- 27.3% - 40.8%
- 40.9% - 72.5%
Mapping Population-Level Data

Figure 7. Percent of Population Living Below the Poverty Level by Census Tract, Richmond Area, 2000
## Preliminary Analyses

### Patient Characteristics by Condom Use (N = 7,074)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Condom Use Last Sex</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>p-value</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH Black</td>
<td>1,645</td>
<td>31.11</td>
<td>0.2564</td>
</tr>
<tr>
<td>NH White</td>
<td>266</td>
<td>28.48</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>132</td>
<td>31.50</td>
<td></td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1,010</td>
<td>31.97</td>
<td>0.0421</td>
</tr>
<tr>
<td>Female</td>
<td>1,033</td>
<td>29.67</td>
<td></td>
</tr>
<tr>
<td><strong>Age Group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-19 years</td>
<td>471</td>
<td>34.91</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>20-29 years</td>
<td>1,102</td>
<td>31.54</td>
<td></td>
</tr>
<tr>
<td>30-49 years</td>
<td>470</td>
<td>26.14</td>
<td></td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; High school</td>
<td>337</td>
<td>28.66</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>High school graduate/GED</td>
<td>759</td>
<td>28.19</td>
<td></td>
</tr>
<tr>
<td>&gt; High school</td>
<td>886</td>
<td>34.58</td>
<td></td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>1,203</td>
<td>32.45</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Unemployed</td>
<td>402</td>
<td>25.65</td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>174</td>
<td>34.39</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>137</td>
<td>29.59</td>
<td></td>
</tr>
</tbody>
</table>
### Preliminary Analyses

**Patient Characteristics by Number of Sex Partners in Past 3 Months (N = 7,074)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>1 partner</th>
<th></th>
<th>2 or more partners</th>
<th></th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH Black</td>
<td>2,892</td>
<td>54.79</td>
<td>2,395</td>
<td>45.30</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>NH White</td>
<td>483</td>
<td>53.97</td>
<td>412</td>
<td>46.03</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>293</td>
<td>67.51</td>
<td>141</td>
<td>32.49</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1,448</td>
<td>45.85</td>
<td>1,710</td>
<td>54.15</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Female</td>
<td>2,220</td>
<td>64.20</td>
<td>1,238</td>
<td>35.80</td>
<td></td>
</tr>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-19 years</td>
<td>735</td>
<td>54.44</td>
<td>615</td>
<td>45.56</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>20-29 years</td>
<td>1,880</td>
<td>53.61</td>
<td>1,627</td>
<td>46.39</td>
<td></td>
</tr>
<tr>
<td>30-49 years</td>
<td>1,053</td>
<td>59.86</td>
<td>706</td>
<td>40.14</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; High school</td>
<td>656</td>
<td>56.26</td>
<td>510</td>
<td>43.74</td>
<td>0.1075</td>
</tr>
<tr>
<td>High school graduate/GE</td>
<td>1,530</td>
<td>56.60</td>
<td>1,173</td>
<td>43.40</td>
<td></td>
</tr>
<tr>
<td>&gt; High school</td>
<td>1,358</td>
<td>53.82</td>
<td>1,165</td>
<td>46.18</td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>2,072</td>
<td>56.12</td>
<td>1,620</td>
<td>43.88</td>
<td>0.0033</td>
</tr>
<tr>
<td>Unemployed</td>
<td>825</td>
<td>52.92</td>
<td>734</td>
<td>47.08</td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>255</td>
<td>52.15</td>
<td>234</td>
<td>47.85</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>291</td>
<td>61.39</td>
<td>183</td>
<td>38.61</td>
<td></td>
</tr>
</tbody>
</table>
### Patient Characteristics by Categorized Sex Ratios*, Statified by Sex (N = 7,074)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Men (N=3,411)</th>
<th>Women (N=3,663)</th>
<th>p-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Med</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH Black</td>
<td>86.92</td>
<td>72.46</td>
<td>65.79</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>NH White</td>
<td>8.38</td>
<td>17.91</td>
<td>26.34</td>
<td>.788</td>
</tr>
<tr>
<td>Hispanic</td>
<td>4.70</td>
<td>9.63</td>
<td>7.86</td>
<td></td>
</tr>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-29 years</td>
<td>54.82</td>
<td>53.83</td>
<td>56.23</td>
<td>.5198</td>
</tr>
<tr>
<td>30-49 years</td>
<td>28.95</td>
<td>31.78</td>
<td>29.75</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; High school</td>
<td>20.63</td>
<td>18.85</td>
<td>18.70</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>High school graduate/GED</td>
<td>48.28</td>
<td>44.53</td>
<td>36.72</td>
<td></td>
</tr>
<tr>
<td>&gt; High school</td>
<td>31.10</td>
<td>36.62</td>
<td>44.58</td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>59.15</td>
<td>62.17</td>
<td>65.36</td>
<td>.1472</td>
</tr>
<tr>
<td>Unemployed</td>
<td>30.27</td>
<td>27.54</td>
<td>24.58</td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>6.12</td>
<td>6.08</td>
<td>5.59</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>4.46</td>
<td>4.20</td>
<td>4.47</td>
<td></td>
</tr>
<tr>
<td>Number of sex partners in the last 3 months</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 partner</td>
<td>45.77</td>
<td>45.31</td>
<td>46.73</td>
<td>.8502</td>
</tr>
<tr>
<td>2 or more partners</td>
<td>54.23</td>
<td>54.69</td>
<td>53.27</td>
<td></td>
</tr>
<tr>
<td>Condom use at last intercourse</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>30.04</td>
<td>34.51</td>
<td>33.05</td>
<td>.0594</td>
</tr>
<tr>
<td>No</td>
<td>69.96</td>
<td>65.49</td>
<td>66.95</td>
<td></td>
</tr>
</tbody>
</table>

* Low Sex Ratio: <0.899; Medium Sex Ratio: 0.899-0.978; High Sex Ratio: >0.978 (based on tertile distribution)
### Patient Characteristics by Mean Sex Ratios, Statified by Sex (N = 7,074)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Men (N=3,411)</th>
<th>Mean</th>
<th>p-value</th>
<th>Women (N=3,663)</th>
<th>Mean</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH Black</td>
<td>0.903</td>
<td></td>
<td>&lt;.0001</td>
<td>0.893</td>
<td></td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>NH White</td>
<td>0.999</td>
<td></td>
<td></td>
<td>0.980</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.952</td>
<td></td>
<td></td>
<td>0.962</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-19 years</td>
<td>0.912</td>
<td></td>
<td>0.5123</td>
<td>0.921</td>
<td></td>
<td>0.0534</td>
</tr>
<tr>
<td>20-29 years</td>
<td>0.922</td>
<td></td>
<td>0.9083</td>
<td>0.908</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-49 years</td>
<td>0.923</td>
<td></td>
<td>0.896</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; High school</td>
<td>0.915</td>
<td></td>
<td>&lt;.0001</td>
<td>0.888</td>
<td></td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>High school graduate/GED</td>
<td>0.906</td>
<td></td>
<td></td>
<td>0.893</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; High school</td>
<td>0.947</td>
<td></td>
<td></td>
<td>0.932</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>0.927</td>
<td></td>
<td>0.1417</td>
<td>0.912</td>
<td></td>
<td>0.0329</td>
</tr>
<tr>
<td>Unemployed</td>
<td>0.913</td>
<td></td>
<td></td>
<td>0.886</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>0.936</td>
<td></td>
<td></td>
<td>0.915</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>0.899</td>
<td></td>
<td></td>
<td>0.912</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of sex partners in the last 3 months</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 partner</td>
<td>0.916</td>
<td></td>
<td>0.6316</td>
<td>0.911</td>
<td></td>
<td>0.2446</td>
</tr>
<tr>
<td>2 or more partners</td>
<td>0.920</td>
<td></td>
<td></td>
<td>0.902</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condom use at last intercourse</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.929</td>
<td></td>
<td>0.1879</td>
<td>0.913</td>
<td></td>
<td>0.3475</td>
</tr>
<tr>
<td>No</td>
<td>0.918</td>
<td></td>
<td></td>
<td>0.906</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Multi-Level Modeling Results

### Adjusted Odds Ratios for Condom Use, Statified by Sex (N = 6,093)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95%CI)</td>
<td>OR (95%CI)</td>
<td>OR (95%CI)</td>
</tr>
<tr>
<td>Sex Ratio</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>low (&lt;0.899)</td>
<td>0.98 (0.95, 1.02)</td>
<td>0.98 (0.94, 1.02)</td>
<td>0.99 (0.94, 1.03)</td>
</tr>
<tr>
<td>med (0.899-0.978)</td>
<td>1.00 (0.97, 1.04)</td>
<td>1.03 (0.98, 1.08)</td>
<td>0.97 (0.92, 1.02)</td>
</tr>
<tr>
<td>high (&gt;0.978)</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

### Adjusted Odds Ratios for More than 2 Sex Partners, Statified by Sex (N=6,053)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95%CI)</td>
<td>OR (95%CI)</td>
<td>OR (95%CI)</td>
</tr>
<tr>
<td>Sex Ratio</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>low (&lt;0.899)</td>
<td>1.01 (0.97, 1.04)</td>
<td>0.99 (0.94, 1.04)</td>
<td>1.02 (0.97, 1.07)</td>
</tr>
<tr>
<td>med (0.899-0.978)</td>
<td>1.02 (0.99, 1.06)</td>
<td>1.01 (0.96, 1.07)</td>
<td>1.03 (0.98, 1.09)</td>
</tr>
<tr>
<td>high (&gt;0.978)</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Summary of Results

• At the population level…
  – Sex ratios significantly associated with gonorrhea rates, poverty, black race, marriage rates, education

• At the individual level…
  – Condom use associated with age, sex, education, and employment
  – Number of sex partners associated with race/ethnicity, sex, age, and employment

• After multi-level analysis…
  – No significant association between sex ratios and high-risk sexual behaviors
Study Limitations

• Population limited to individuals who visited STD clinics

• Limited information on interview forms
  – Self-reported behaviors
  – Missing information on marital status

• 2000 Census data
Future Directions

- Improved data sources
  - Geolytics population estimate data
- Other contextual factors
  - Neighborhood deterioration (broken windows)
  - Incarceration and crime rates
  - Racial and economic segregation
Parting Thoughts

…until underlying social determinants are addressed, the success of interventions to address racial disparities in STD risk and infection will be limited.

- Hogben and Leichliter (2008)
Questions?